TABLE OF CONTENTS

Trouble-shooting instructions	: VWW-5010
BOSCH system	: Ecotronic 4.0 B
Make of vehicle	: VW
Basic microcard	: KFZ-0..

SPECIAL FEATURES

* This microcard, valid at the time of publication, contains trouble-shooting instructions for the following VW models:
  Golf 10.87->
  1,6l/4-cyl. engine code letter. PN
  Passat, Jetta 10.87->
  1,6l/4-cyl. engine code letter. PP

* Ecotronic (ECO 4.0 B) with 25-pole control unit.

* The control unit features self-diagnosis. Should a fault occur in the system, it is stored in the fault memory and can be read out with the aid of the diagnosis evaluation unit KDAW 9980.
  The control unit makes use of specified substitute values should a sensor fail.
* The system is similar to the Ecotronic (ECO 3), Mercedes-Benz
  See basic microcard.

SPECIAL FEATURES (continued):

The control range of the lambda closed-loop control system can be indicated by means of an evaluation unit KDAW 9980 or by means of a commercially available LED test lamp.

Testing and adjusting lambda closed-loop control range:

The correct setting of the lambda closed-loop control range is indicated by way of flashing pulses from the LED.
Initiation of indication:
- Switch off ignition for at least 20 s.
- Connect evaluation unit for flashing code KDAW 9980 socket 2 and socket 4 to test coupling for diagnosis (free lead in engine compartment).
  Connect evaluation unit socket 1 to $+U_B$ and socket 3 to ground.
  Keep button on evaluation unit pressed and start engine.
- Release button on evaluation unit after engine has been running for at least 4 s.
- Bring lambda sensor up to operating temperature; to do so, increase engine speed for 1 min. to between in excess of 2000 and max. 3500 min^{-1}.
  Note: If the engine speed is increased to in excess of 4000 min^{-1}, the indication is reset; initiate indication again.

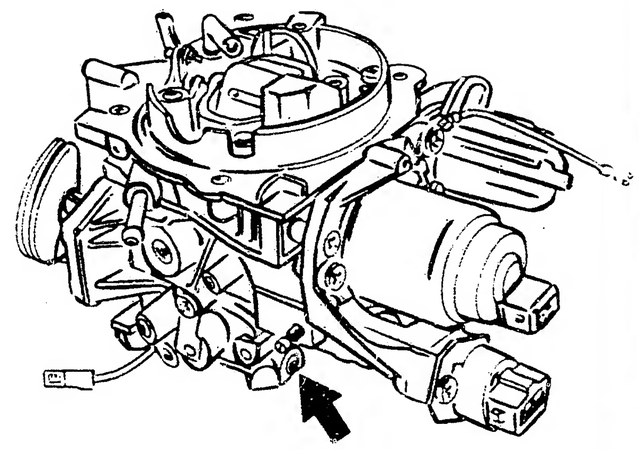
Lambda closed-loop control within control range:
LED flashes 1,5 times per second.

Lambda closed-loop control on rich stop:
LED lights up all the time.

Lambda closed-loop control on lean stop:
LED does not light up.

Adjust closed-loop control range by way of idle-mixture-adjusting screw (top picture, arrow).
Note: LED flickers (25 times per second)
- Lambda sensor not at operating temperature
- Open-circuit in lead to lambda sensor.

Testing ACF bleeder valve for leaks:
Remove ACF bleeder valve.
Connect vacuum pump (e.g. Mityvac) to intake-manifold connection of valve (center picture, 2).
1. Valve deenergized -> continuity (vacuum build-up not possible).
2. Actuate valve with battery voltage (10...15 V) (use connecting lead KDJE 7450/70) (bottom picture).
Generate vacuum of approx. 0,5 bar.
Permissible drop in pressure: 0,25 bar in approx. 10 s.



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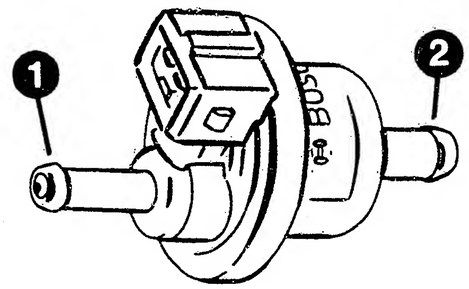

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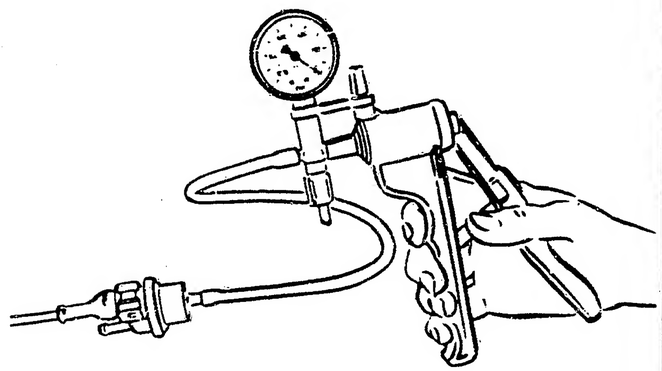

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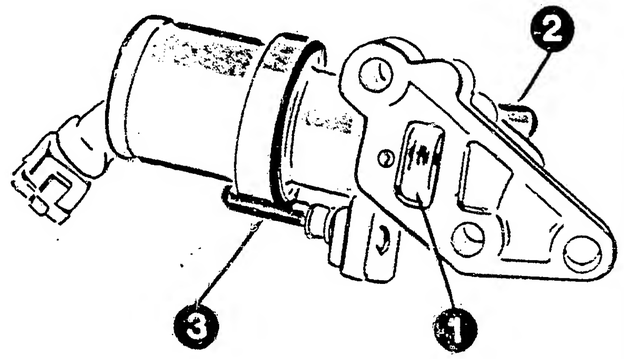
SPECIAL FEATURES (Continued)

Check tank ventilation:

Pull vacuum hose off at tank ventilation valve (connection to active-carbon container) and connect up vacuum gauge.
Engine idling at operating temperature (approx. + 80 Grad C).
Lambda control in operation. Observe vacuum reading.

Set value:
Change between 400...600 mbar and 700...1000 mbar
Increase engine speed to approx. 3000 1/min.

Set value:
500...1000 mbar



KMK 02234

If set value is not attained, check vacuum hose to carburetor for leaks/check tank ventilation valve.

Visually inspect active-carbon container. Check for leaks in vacuum lines between active-carbon container and tank ventilation valve, float-chamber vent valve and tank.

Check electr. float-chamber vent valve (top picture):
Switch off ignition and check voltage supply.

Set value: approx. battery voltage

Unscrew vent valve and apply + 12 V.

Set value:
Valve plate (top picture, item 1) is pulled onto its seat and interrupts connection between float chamber and vacuum connections (top picture, items 2 and 3).

Renew vent valve if set value is not attained.

STRUCTURE, USAGE

These brief instructions essentially comprise vehicle-specific special features and test specifications (set values).

In line with the customer complaint, the trouble-shooting chart leads to various causes/component faults.
A detailed description of trouble-shooting is given in the trouble-shooting chart in the basic instructions.
NOTE: Even if reference is made to basic instructions, the set values, terminal assignments and special features indicated in these vehicle-specific brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

Pay attention to information given in basic instructions so as to avoid endangering people and in order to prevent damage to engine, trigger boxes, control units or ignition system.

IMPORTANT!
Heavy duty ignition system with hazardous high and low voltage!

Coming into contact with components or terminals which carry voltage may be fatal (on both primary and secondary sides).

TROUBLE-SHOOTING CHART

Customer complaint (fault symptoms)
1. Starting motor operates, engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Idle problems (engine speed, exhaust gas).
4. Poor throttle take-up, flat spot during acceleration.
5. Engine missing (ignition, induction of fuel).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.

1	2	3	4	5	6	7	8	9	10	Cause (component fault)
*	*	*	*	*	*	*	*	*	*	Evaluate self-diagnosis
								*	*	Poor grade of fuel
*			*	*	*					Test fuel pressure
	*			*	*					Test fuel delivery
*	*	*	*	*	*	*				Choke-valve flap not moving freely
*	*			*	*					Test float/needle valve
*	*	*	*	*	*					Dirt in carburetor
	*	*	*	*	*					Leak in intake system
	*	*								Defective intake-manifold heater
	*	*								Defective intake-air preheater
					*					Defective exhaust system
		*	*							Check tank ventilation

TROUBLE-SHOOTING CHART

1. Starting motor operates, engine fails to start or starts only with difficulty.	2. Engine starts but then dies.	3. Idle problems (engine speed, exhaust gas).	4. Poor throttle take-up, flat spot during acceleration.	5. Engine missing (ignition, induction of fuel).	6. Maximum engine power/top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	Cause (component fault)
	*					*				Test setting of throttle valve, stage I
	*	*	*	*	*					Wrong type of nozzle
		*		*						Vacuum unit, stage II
		*	*		*					Test setting of throttle valve, stage II
			*		*	*				Test setting of throttle linkage
		*	*							Throttle valve worn
	*	*		*						Test TD signal
					*	*				Test enrichment pipe
		*	*							Test bypass heater
*					*	*				Defective float-chamber change-over valve
		*	*							Test ACF (visual inspection)
		*								Test vent. filter, throttle-valve actuator

TROUBLE-SHOOTING: HOW TO USE SELF-DIAGNOSIS:

This vehicle is fitted with a control unit which features self-diagnosis. Trouble-shooting must therefore always be commenced with self-diagnosis.
The self-diagnosis is split up into two parts:

1. Readout of fault memory (self-diagnosis)

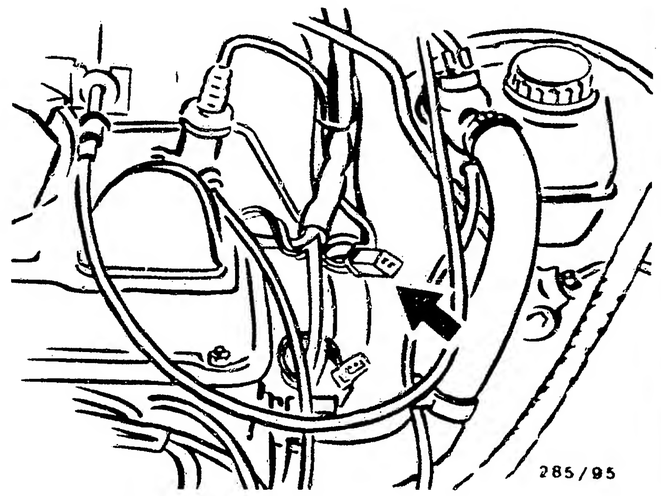
2. Actuator diagnosis

Following stimulation of the self-diagnosis by way of the diagnosis evaluation unit, all electronic control units installed in the vehicle, which feature self-diagnosis, are prompted to provide diagnosis output.
The indicated Ecotronic faults are explained in the self-diagnosis test table starting on Coordinate 13.
The self-diagnosis test table contains fault indication, component tested, test terminals at control-unit plug, cause of fault, test instructions and set values.

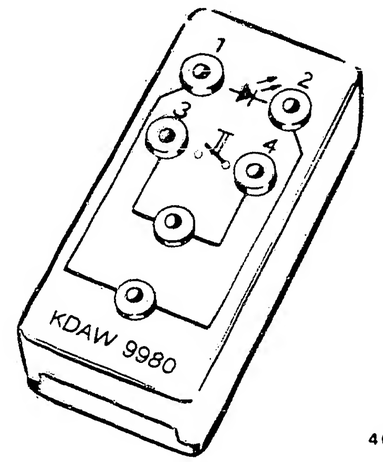
The trouble-shooting charts as of Coordinates 06 are only to be employed if there is no fault stored in the fault memory, but a customer complaint has nevertheless been received.
The trouble-shooting charts only contain those components which are not tested by way of self-diagnosis.

HOW TO USE SELF-DIAGNOSIS AND SELF-DIAGNOSIS TEST TABLE

Connecting evaluation unit for flashing code KDAW 9980 (center picture):
Connect evaluation unit for flashing code KDAW 9980 socket 2 and socket 4
to test coupling for diagnosis (free lead in engine compartment, (top picture, arrow).
Connect evaluation unit socket 1 to $+U_B$ and socket 3 to ground.



Activating self-diagnosis:
Allow engine to idle (if applicable, perform test drive beforehand)
or crank starting motor for approx. 6 seconds (do not switch off ignition).
Press button on evaluation unit for more than 4 s.
Output of the self-diagnosis commences with a start signal (bottom picture, a) (fault lamp lights up for approx. 2,5 seconds).



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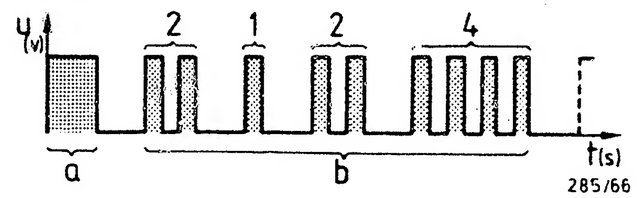
Activating actuator diagnosis:

On vehicles with Bosch ignition trigger box additionally connect term. 7 of ignition trigger box to + 12 V.
Switch off ignition (min. 20 sek.).
Keep button on diagnosis evaluation unit pressed, switch on ignition.
Release button after more than 4 seconds.
With output of actuator diagnosis
(flashing code 4432, 4323, 4324, 4342 and 4343)
the corresponding actuators are simultaneously activated during flashing-code output and can be checked by listening to or feeling them (flashing code only indicates actuated component).

Note: Check TD signal if actuator diagnosis not possible.

Continuation of diagnosis:

Once a fault has been read out, the next fault is output or the next actuator activated by pressing the button again (more than 4 s).



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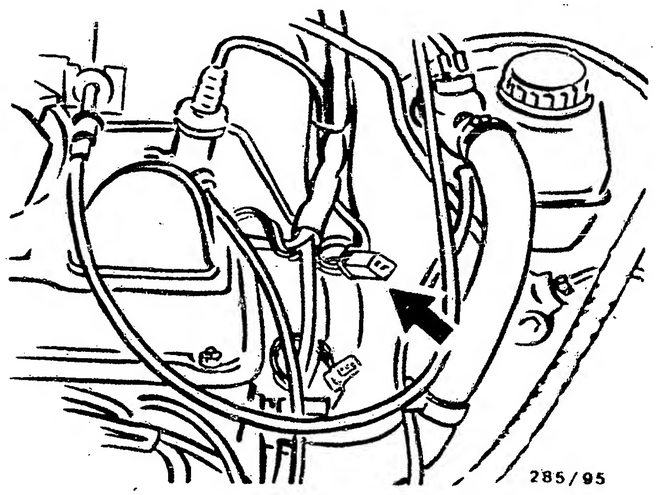
HOW TO USE SELF-DIAGNOSIS AND SELF-DIAGNOSIS TEST TABLE

N o t e :

The fault memory is cleared 15 seconds after switching off the ignition.
Should it not be possible to stimulate the control unit to provide diagnosis output, the voltage supply of the control unit and the diagnosis line from the control unit term. 6 to the diagnosis test coupling (free line in engine compartment, top picture, arrow) are to be checked for open circuit.
If there is no engine-speed signal, the LED lights brightly without button pressed on evaluation unit and the fault memory cannot be read out.



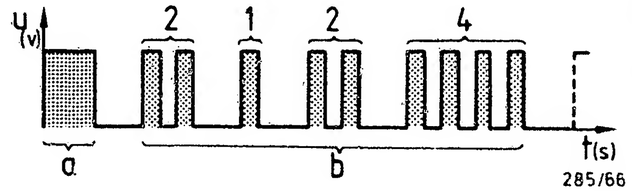
Flashing-code evaluation (center picture, b):

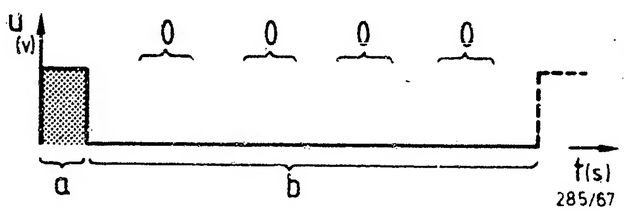
The flashing code for each fault consists of four flashing-pulse blocks.
Each block represents a number and features between 1 and 4 pulses.
One pulse corresponds to the number 1, whereas four pulses correspond to the number 4.
The fault lamp lights briefly with each pulse.

The interval between the blocks is longer than between the individual pulses.
Between two fault codes, continuation is effected by pressing the button again for more than 4 seconds.
The flashing code 4444 is output if there is no fault stored in the control unit.

If there is a fault stored in the control unit, the first fault (center picture, b) is output following the start signal.
If there is a further fault stored, its flashing code follows on effecting continuation by way of renewed short to ground.

Continuation must be effected until the flashing code 0000 (see bottom picture) indicates the end of self-diagnosis.
The fault memory is cleared when the ignition is switched off and the main relay is deenergized approx. 15 seconds later.





SELF-DIAGNOSIS TEST TABLE

Fault display Flashing code	Testing of component/function	Test instructions/test conditions	Terms.		Set values
4444	Control unit	Control unit indicates that there is no fault in fault memory.	30		—
1232	Throttle-valve positioner vent/evacuation valve (short to ground or open circuit)	Perform actuator diagnosis. (Only indicated as of control unit 0 285 007 042, .. 43)	—		—
2124	Potentiometer in throttle-valve positioner. (Short to ground or open circuit).	Resistance, potentiometer, throttle valve and throttle-valve positioner (parallel):	18	7	0,7...1,3 k Ω
		Wiper resistance, potentiometer in throttle-valve positioner:			
		(actuate evacuation valve in throttle-valve positioner during test and pull back throttle-valve positioner with vacuum hand pump). Continuous decrease in resistance.	17 17	7 7	min. < 400 Ω max. 1,4...2,6 k Ω
2212	Throttle-valve potentiometer (short to ground/ open circuit)	Resistance, potentiometer, throttle valve and throttle-valve positioner (parallel):	18	7	0,7...1,3 k Ω
		Wiper resistance, throttle-valve potentiometer:			
		Run engine at idle. Seal off vent side of throttle-valve positioner. Switch off engine. Switch on ignition.			
		Accelerator in idle position:	11	7	min. < 270 Ω
		Accelerator in full-throttle position:	11	7	max. 1,4...2,4 k Ω
		Resistance constantly changes between min. and max.	11	7	max. 1,4...2,4 k Ω
2214	Maximum speed exceeded	Max. speed 7000 1/min. exceeded whilst driving.	25	20	6950 1/min
		(Check speed limitation on dynamometer)	12	12	-0,6...2,8 A

SELF-DIAGNOSIS TEST TABLE (continued)

Fault display Flashing code	Testing of component/function	Test instructions/test conditions	Terms.	Set values
2312	Coolant temperature sensor (short to ground/ open circuit)	Resistance of temperature sensor: at 20 °C at 80 °C	21 7 21 7	2...3 k Ω 280...360 Ω
2341	Lambda control at control limit	Check Lambda control and readjust control range: Initiate display of Lambda control range.	6	LED on evaluation unit flashes at 1,5 Hz
2342	Lambda sensor at control limit	Check lead from control unit term. 8 to connector of Lambda sensor for short to ground or battery positive: (Connector of Lambda sensor pulled off)	8 (-) 8 (+) 8	> 1 M Ω > 1 M Ω approx. 0 Ω
2412	Intake-air temperature sensor (short to ground/ open circuit).	Resistance of temperature sensor: at 20 °C at 80 °C	5 7 5 7	2 ..3 k Ω 280...360 Ω
4432	Choke-valve actuator Short to ground	Insulation resistance of choke-valve actuator: Winding resistance of choke-valve actuator:	10 12 10 12	< 1 M Ω 0,9...1,7 Ω
2122	No TD-signal	Check TD-signal whilst starting: Fault is only indicated if TD-signal was present when engine was last started. (Only indicated as of control unit 0 285 007 042 ..043)	25 20	Rectangular pulses between 0 and 12 V
0000	End of diagnosis output	Control unit indicates that diagnosis output is over. Fault lamp flashes at 2,5 sec.-intervals (start signal).	—	———

SELF-DIAGNOSIS TEST TABLE (continued)
Final-controlling-element diagnosis (component is activated by control unit during flashing-code output).

Flash code	Testing of components/function	Test instructions/Test conditions	Termin-als	Set values
4432	Choke-valve actuator	Choke-valve actuator is activated during diagnosis output. Insulation resistance of choke-valve actuator: Winding resistance of choke-valve actuator:	 10 12 10 12	 greater than 1M Ω less than 10 Ω
4343	Activated-carbon-filter bleeder valve	Final-controlling-element diagnosis: bleeder valve is actuated during flashing-code output. Insulation resistance Winding resistance	 15 2 15 23	 greater than 1 M Ω less than 100 Ω
4342	Relay for intake pre-heating	Final-controlling-element diagnosis: relay is actuated during flashing-code output. Insulation resistance Winding resistance	 14 2 14 23	 greater than 1 M Ω less than 100 Ω
4323	Ventilating valve in throttle-valve actuator	Final-controlling-element diagnosis: ventilating valve is actuated during flashing-code output. Insulation resistance, ventilating valve: Winding resistance, ventilating valve:	 9 2 9 23	 greater than 1M Ω 20...80 Ω
4324	Evacuating valve in throttle-valve actuator	Final-controlling-element diagnosis: evacuating valve is actuated during flashing-code output. Insulation resistance, evacuating valve: Winding resistance, evacuating valve:	 3 2 3 23	 greater than 1M Ω 20...80 Ω
0000	Diagnosis output complete	Control unit indicates that the diagnosis output is complete. Fault lamp flashes at 2,5 s. interval (start signal).	—	———

TEST SPECIFICATIONS:

Idle speed: 900±75 min $^{-1}$
Note: the idle speed is controlled and cannot be adjusted.

Engine-speed limitation 7000 min $^{-1}$

Exhaust-gas adjustment:
Test CO value at sampling pipe before catalytic converter: %CO by vol. 0,2...1,0
To do this, hose for engine ventilation and lead to lambda sensor are disconnected.

Fuel pressure: 0,1...0,3 bar
Minimum fuel delivery (at 2000 min $^{-1}$) 1 l/min

Float weight: (dry) 7,9±0,5 g
Float height: 27,5±1,0 mm
(Float level cannot be adjusted)

Throttle-valve potentiometer
Total resistance: 1,4...2,6 kΩ
Wiper resistance in correcting range: min. less than 270 Ω
max. 1,4...2,4 kΩ

Choke-valve actuator.
Winding resistance: 0,9...1,7 Ω

Basic setting, throttle valve
Stage I (with feeler gauge) 3,15 mm
Stage II a = 0,03±0,02 mm

Release and forced return
Stage II: Y = 1,0±0,3 mm
Z = 0,4±0,2 mm

Float-chamber change-over valve
Winding resistance less than 50 Ω

Activated-carbon-filter bleeder valve
Winding resistance: 20...90 Ω

TEST SPECIFICATIONS (continued):

Choke-valve actuator:
Evacuating valve (term. 1/2): 20...70 Ω
Venting valve (term. 6/7): 20...70 Ω
Total potentiometer resistance (term. 3/4): 1,4...2,6 kΩ
Wiper resistance in correcting range (term. 5/3): min. < 400 Ω
max. 1,4...2,4 kΩ

Temperature sensor (intake air)
Internal resistance at 20°C: 2,0...3,0 kΩ
at 80°C: 280...360 Ω

Heating element, intake-manifold heater:
Internal resistance at 20°C: approx. 0,25...0,5 Ω

Heating element, part-load channel:
Internal resistance at 20°C: approx. 1,5...2,5 Ω

Nozzles:

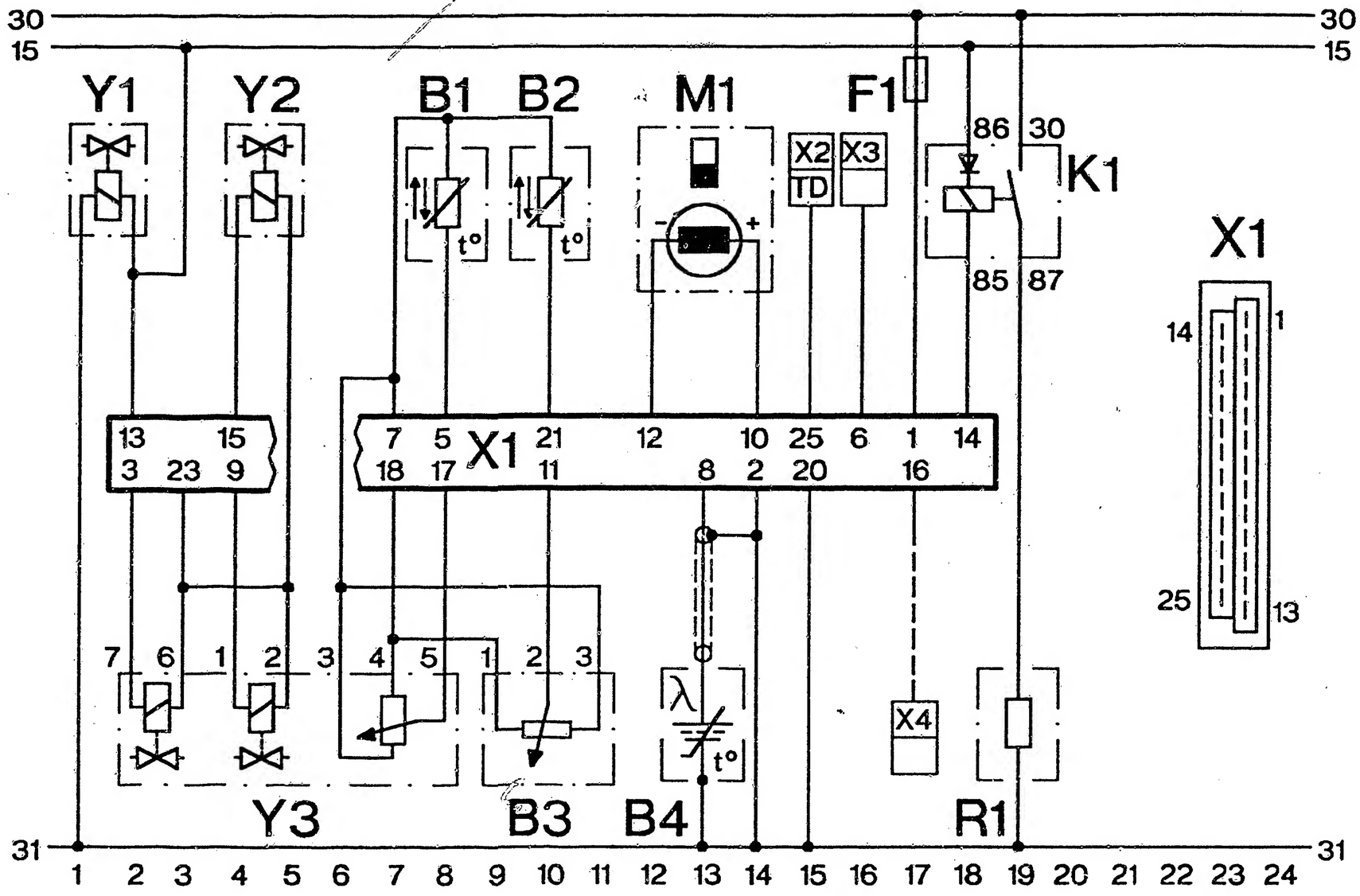
	Stage 1	Stage 2
Main nozzle	x 105	x 110
Idle fuel nozzle	x 45	
Acceleration fuel nozzle		90
Air correction nozzle (with mixing pipe)	x 110	x 105
Acceleration air nozzle		x 130

Pipe for full-load enrichment
Height above pre-atomizer 13,5±1,0 mm

Tightening torques
Carburetor mount 7 Nm

Please refer to equipment and Autodata microcard for settings as regards valve clearance and other engine-related data.

KMK 04350



ELECTRICAL TERMINAL DIAGRAM

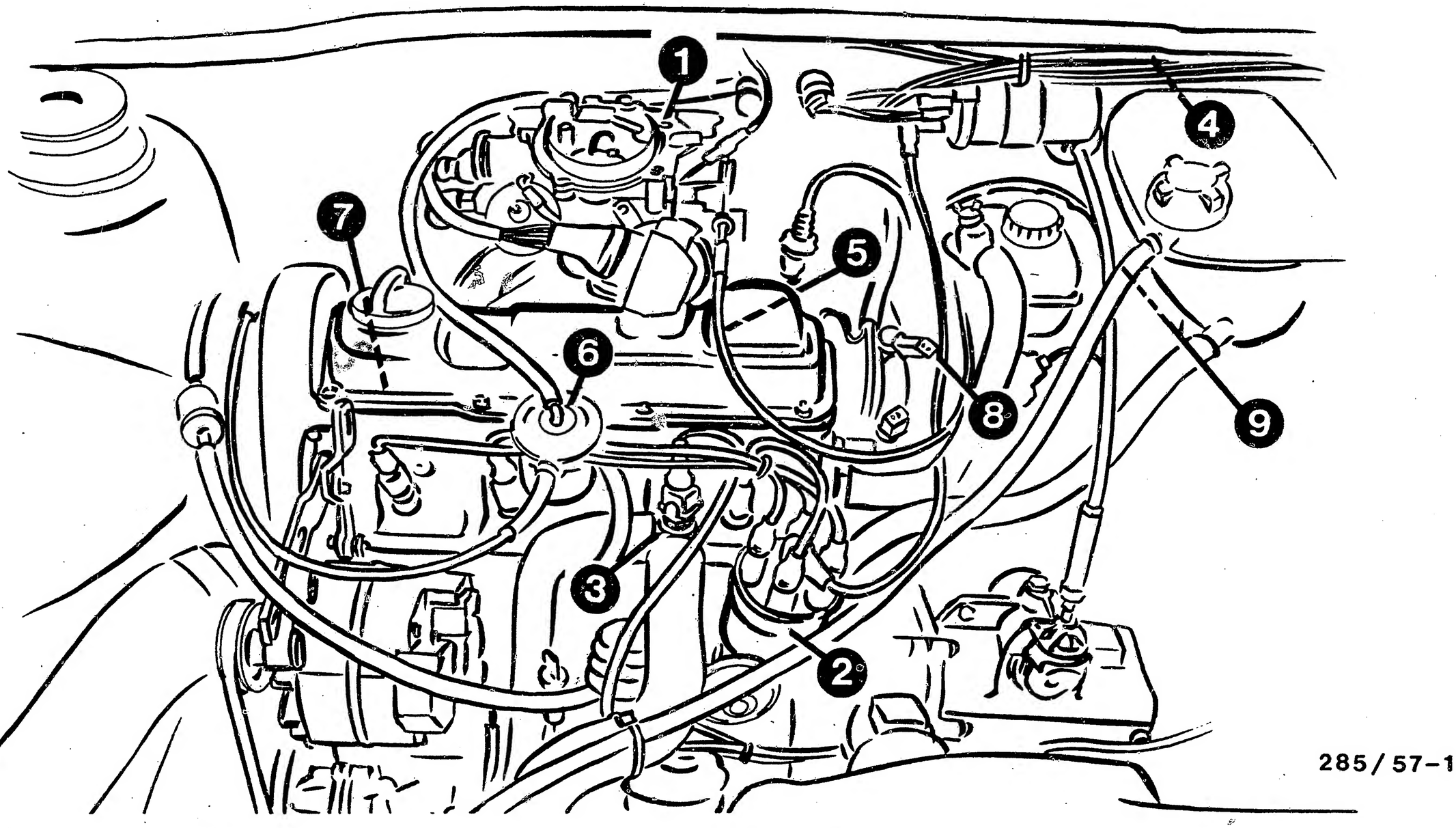
B1 = Coolant temperature sensor
B2 = Intake-air temperature sensor
B3 = Throttle-valve potentiometer
B4 = Lambda sensor
F1 = Fuse, control unit

K1 = Relay, intake-manifold htg.
M1 = Choke-valve actuator
R1 = Intake-manifold heating
X1 = Control-unit plug
X2 = Connector, ignition trigger box

X3 = Diagnosis plug
X5 = Connector, transmission identifier
Y1 = Float-chamber ventilation switching valve
Y2 = Tank-ventilation valve
Y3 = Thrott.-valve positioner

A23 — ⟹

A24 — ⟸



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1 = Carburetor
2 = Ignition distributor
3 = Temperature sensor Coolant
4 = Ecotronic control unit (under cover)
5 = Temp. sens., intake manifold
6 = Vapor bubble eliminator
7 = Sampling pipe for CO measurement
8 = Free lead for adjusting closed-loop control range of lambda sensor Lambda sensor is installed in flame tube
9 = ACF

INSTALLATION POSITION OF COMPONENTS

INSTALLATION POSITION OF COMPONENTS

The relay for the intake air preheating is located in the central fuse box on the left of the passenger compartment.

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TABLE OF CONTENTS

Trouble-shooting instructions	:	MB-5008
BOSCH system	:	KE 3.1 - Jetronic
Vehicle make	:	MERCEDES-BENZ
Basic microcard	:	PKW-014

Tests without coordinate details are not applicable in these trouble-shooting instructions.

SPECIAL FEATURES

* This microcard contains the trouble-shooting instructions for the following Mercedes-Benz model valid at the time of writing:

  300 E,SE,SEL, 3,01/6Zyl. CH/S 12.85->

* Trouble-shooting with these instructions can be done only when the data of the "After-Sales-Service Information for Vehicles" (KFZ-000) correspond to the the vehicle type and the BOSCH number of the KE-Jetronic control unit installed.

* Control unit with digital technology, characteristic-map controlled by microprocessor.

* Electronically-controlled idle-speed regulation with single-winding rotary actuator, without bypass adjusting screw.

* Activated carbon filter and regeneration valve for returning gasoline fumes into the intake manifold (Fuel evaporation control system).

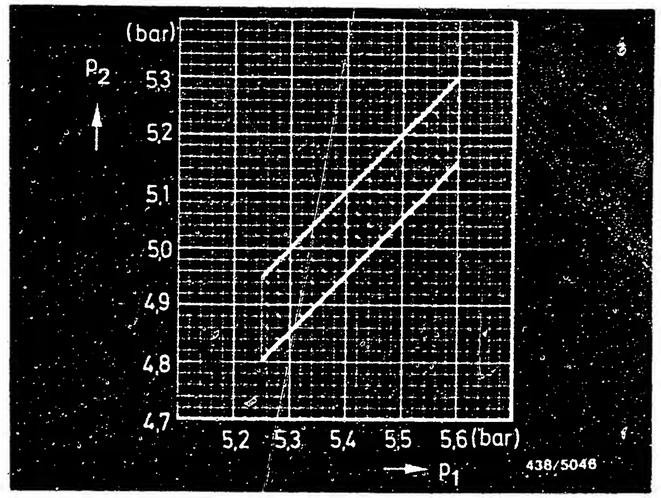
* Exhaust-gas recirculation (non-Bosch system)

Important note:

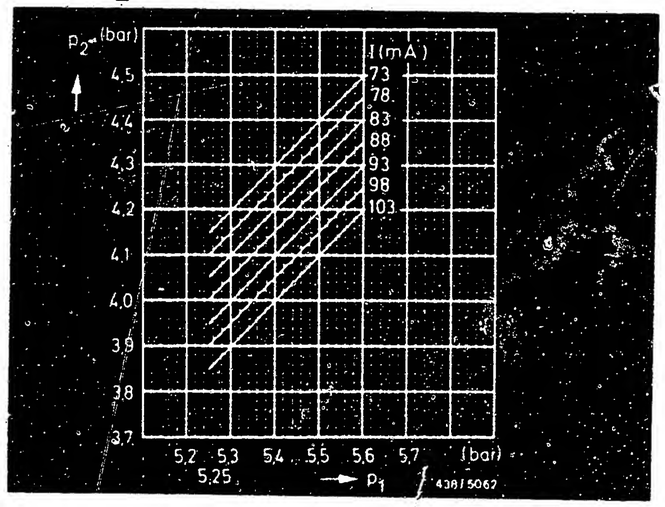
When referring to a basic microcard, note that the test specifications should always be taken from the vehicle-specific brief instructions.

TEST SPECIFICATIONS

No.	Testing/Test condition	Test specification	
1	Electric fuel pump – fuel delivery:	At least 1400 cm ^{3} /min	
2	Primary pressure:	5,25...5,6 bar	
3	Differential pressure: Suppression of peak coil current: Actuate starting motor with fuel-pump relay disconnected. Do not switch off ignition after starting. Take lower-chamber pressure set value "warm" from top chart corresponding to primary pressure measured. (Actuator current 0 mA) Take lower-chamber pressure set value "cold" from bottom chart corresponding to primary pressure measured and actuator current. Tolerance ± 0.15 bar. Simulation of "cold" state: press push-button 3 at test adapter.		
4	Leakage test, complete system: Minimum pressure after 10 mins: Minimum pressure after 20 mins:	 2,7 bar 2,6 bar	
5	Injection valves, opening pressure:	3,0...4,1 bar	
6	Fuel deliveries, comparative measurement: (Actuator current 0 mA) Idle: Part load: Full load: Min. delivery at max. air-flow sensor plate defl.:	Setting point: (cm ^{3} /min) 6,0 40,0 100,0 140 cm ^{3} /min	Max. permis. delivery: (cm ^{3} /min) 6,6 42,5 109,0



p_1 = Primary pressure
p_2 = Lower-chamber pressure



B03 —⟹

B04 —⟸⟹

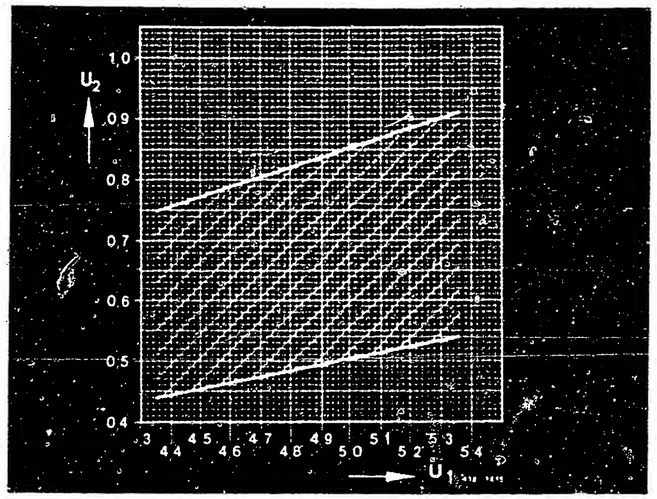
No.	Testing/requirements for testing	Test specification
7	KE-throttle flow-through quantity:	130...150 cm^3 /min
8	Air-temperature sensor (NTC I): Air temperature +15...+30°C:	 1,3...3,6 k Ω
9	Engine-temperature sensor (NTC II): Engine cold (+15...+30°C): Engine warm (approx. +80°C):	 1,3...3,6 k Ω 250...390 Ω
10	Idle-mixture-adjusting screw basic setting: Fuel-distributor support - needle bearing:	 20,5...21,6 mm
11	Idle-speed adjustment: Idle-speed regulation: Adjustment of the idle air quantity not possible. Engine must be at operating temperature for testing. Idle speed: Shift to driving position, engine speed: CO concentration in exhaust: Adjust at idle-mixture-adjusting screw. After correction, repeat measurement.	 720...820 min^{-1} 600...700 min^{-1} 0,3...0,9 vol.-%

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

No.	Switch/Btn V	Ω	Btn	Under test	Test pins	Test conditions	Test specifications
1	V	4	–	Int. resistance(R_i) pressure actuator	12–10	Disconnect control-unit lead plug.	20...30 Ω
2	V	5	–	Resistor NTC II (engine)	21– 2	Engine temperature +15°...+30° C: approx. +80° C:	1,3...3,6k Ω 250...390 Ω
3	V	6	–	Resistor NTC I (intake air)	11– 2	Air temperature in area of NTC I: +15°...+30° C:	1,3...3,6k Ω
4				Signal, altitude sensor		Connect control unit. Switch on ignition. Voltmeter connection to blue Ω sockets. Signal altitude-dependent: 0 meters (sea level): 500 meters: 1000 meters: 1500 meters: 2000 meters: 3000 meters:	Test step not applicable!
5	V	9	–	Throttle-valve switch, idle	13– 2	Switch off ignition. Disconnect control-unit lead plug. Throttle valve closed: open:	0...10 Ω > 1000 Ω
6	V	10	–	Throttle-valve switch, full load	5– 2	Throttle valve closed: fully open:	> 5000 Ω 0...10 Ω
7	V	11	–	Microswitch idle linkage	24– 2	Throttle valve closed: open:	0...10 Ω infinite Ω
8	V	12	–	Ground, control unit	20– 2		0...10 Ω
9	V	13	–	Ground, pin 7	7– 2	Switch off ignition. Connect control unit.	0...10 Ω

TEST SPECIFICATIONS (CONTINUED)

No.	Testing/Test condition	Test specification
12	Signal, air-flow sensor potentiometer: (Checking necessary when poor idle and/or part-load behavior) Measurement using test adapter and voltmeter. Determine supply voltage of potentiometer: Set value (test adapter, V-position 10): Determine potentiometer signal at idle speed. (Test adapter, V-position 11) Set value corresponding to supply voltage: Adjust signal if necessary at trimming potentiometer (at right next to potentiometer pins). Afterwards, re-secure adjusting screw of trimming potentiometer using black sealing compound (e.g Teroson).	 4,35...5,35 V See chart



U_1 = Supply voltage potentiometer

U_2 = Potentiometer voltage signal

SELF-DIAGNOSIS

All Daimler-Benz 4- and 6-cylinder engines in the current series (approx. 10.85) are equipped with self-diagnosis using on-off ratio measurement.

Incorrect input signals from the KE-Jetronic control unit can be displayed with the lambda closed-loop tester at the lambda test output (diagnosis socket, socket 3).

This provides information on short and open circuits. Defects which occur sporadically (e.g. loose contacts) are not indicated. Output of fault signals has priority over output of the lambda closed-loop signal.

We will not go into the defects which can be indicated in more detail here, since the input signals of the KE-Jetronic control unit can be tested with the universal test adapter (rapid-diagnosis chart).

However, if when testing the lambda closed-loop control by means of on-off ratio measurement, a constant on-off ratio is indicated, then the input signals of the KE-Jetronic control unit should be tested (rapid diagnosis chart).

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 WITH KE3 ADAPTER LEAD 1 684 463 169 AND APPROPRIATE MULTITESTER:

The following rapid diagnosis chart makes it possible for the experienced Jetronic expert to quickly check the electric/electronic peripheral and control-unit functions of the the KE-Jetronic, inlcuding the lambda closed-loop control.

Important note on the rapid diagnosis chart:

The "Test conditions" column gives information as to in which test steps the control-unit plug must be connected/disconnected. Make absolutely certain that there is no current at the system when connecting or disconnecting, i.e. the ignition must be switched off and the electric safety circuit must not be short circuited.

The "Test connections" column provides information about the leads connected to the respective measuring path, referring to the assignment in the control-unit plug. Possibly necessary trouble-shooting is with regard to these leads.

A t t e n t i o n :

When carrying out the test, make sure that the trimming plug is in position 1.

Rapid diagnosis chart for universal test adapter ETT 018.01 (continued)

No.	Switch/Btn V	Ω	Btn	Under test	Test pins	Test conditions	Test specifications
10	⏐ V	14	–	Trimming plug Mixture map	22– 2	Disconnect control-unit plug. Disconnect lead plug from air-flow sensor potentiometer and connect socket 1 of plug (in upper installation position) to engine ground. Trimming-plug position 1: 2: 3: 4: 5: 6: 7:	 50... 60 Ω 100...120 Ω 150...190 Ω 230...270 Ω 330...370 Ω 430...470 Ω 570...620 Ω
11	⏐ V	15	–	Transmission switch (only automatic transmission)	16– 2	Connect air-flow sensor potentiometer. Selection lever position P, N: Driving position selected:	 0...10 Ω infinite Ω
12	5	–	–	TD signal	25– 2	Start engine (starting motor):	Voltage undefined
13	6	–	–	Control-unit supply	1– 2	Switch on ignition:	8...15 V
14	7	–	–	Idle actuator supply and continuity	3– 2	Switch on ignition:	8...15 V
15	8	–	–	Tempomat signal	6– 2	Switch Tempomat operation:	——— V
16	9	–	–	Air-conditioner cut-in signal	19– 2	Switch off ignition. Connect control unit. Start engine, switch on air conditioner. Temperature regulator = Minimum temperature	 8...15 V
17	10	–	–	Supply, air-flow sensor potentiometer	18– 2	Switch on ignition:	4,35...5,35 V

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

No.	Switch/Btn V	Ω	Btn	Under test	Test pins	Test conditions	Test specifications
18	11	–	–	Signal, air-flow sensor potentiometer	17– 2	Switch on ignition. Air-flow sensor plate in rest position: Deflect air-flow sensor plate by hand, continuous voltage rise up to max.:	0 V 5,35 V
19	13	–	1	Temperature signal from control unit	9– 2	Switch on ignition. While actuating btn 1:	1,5...1,9 V
20	14	–	–	Consumption signal	4– 2	Start engine – idle: With regulation:	Voltage undefined Voltage change
21	–	–	–	Peak coil current	12–12	Switch on ignition:	–>FD —— : ——— mA FD 550–>: 9...11 mA
22	–	21	1	Warm-up enrichment + 20°C	12–12	Warm up engine – idle. Current value with btn 1 depressed:	–>FD 647 : 10...14 mA FD 648–>: 8...12 mA
23	–	24	2	Actuator current engine at normal operating temperature	12–12	Engine at normal operating temperature, idle. Current value with btn 2 depressed:	–>FD —— : ——— mA FD 550–>: 1... 4 mA
24	–	21	2	Starting enrichment	12–12	So that engine fails to start: disconnect speed relay for electric fuel pump. Short-circuit ignition coil term. 4 to ground via resistance of at least 2 k Ω . (e.g. with sleeve-type suppressor and spark gap) While btn 2 depressed, actuate starting motor. Current rise (max. 1 sec.) to:	–>FD —— : ——— mA FD 550–>: 40...60 mA

FD = Date of manufacture

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

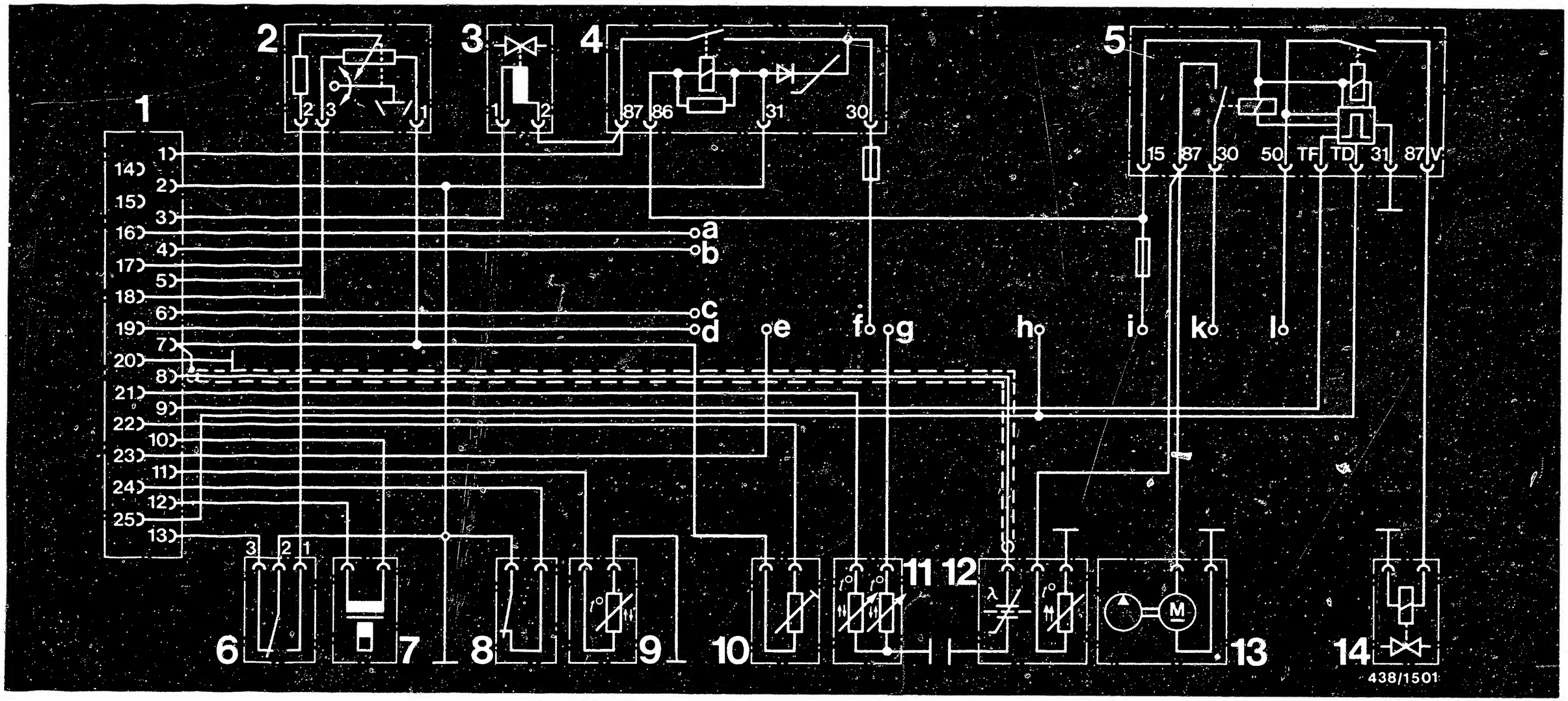
No.	Switch/Btn V	Ω	Btn	Under test	Test pins	Test conditions	Test specifications
25	–	21	1	Post-start enrichment	12–12	Start engine (at normal operating temperature) while actuating btn 1. Current value: Current value constant for a few seconds, then slow speed regulation.	–>FD —— : ——— mA FD 550–>: 9...13 mA
26	–	21	1	Acceleration enrichment	12–12	Engine at normal operating temperature, idle. While actuating btn 1, perform snap acceleration of engine. Thus current rise (approx. 1 sec.) to: Note: Level of current value dependent upon intensity of acceleration (travel/duration of air-flow sensor plate movement).	–>FD —— : ——— mA FD 550–>: 30...60 mA
27	–	–	–	Overrun cut-off	12–12	Re-connect ohmmeter (swap positive and negative). Start engine (normal operating temperature). Drive vehicle on chassis dynamometer or road. Increase speed n briefly to at least approx.: Current reading during falling speed phase: (idle throttle-valve switch closed)	–>FD —— : ——— min $^{-1}$ FD 550–>: 3000 min $^{-1}$ –40...–80 mA

FD = Date of manufacture

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01

No.	Switch/Btn V	Ω	Btn	Under test	Test pins	Test conditions	Test specification
28	–	24	–	Full-load enrichment	12-12	Engine at normal operating temperature, idle. Current value: Briefly push accelerator pedal to floor (full-load throttle-valve switch must switch). During speed rise, current value rises by: A t t e n t i o n: Do this very briefly, so that speed does not rise too much and engine is not damaged.	 ->FD —— : ——— mA FD 550->: 1... 4 mA ->FD —— : ——— mA FD 550->: 6...10 mA

*) FD = Date of manufacture

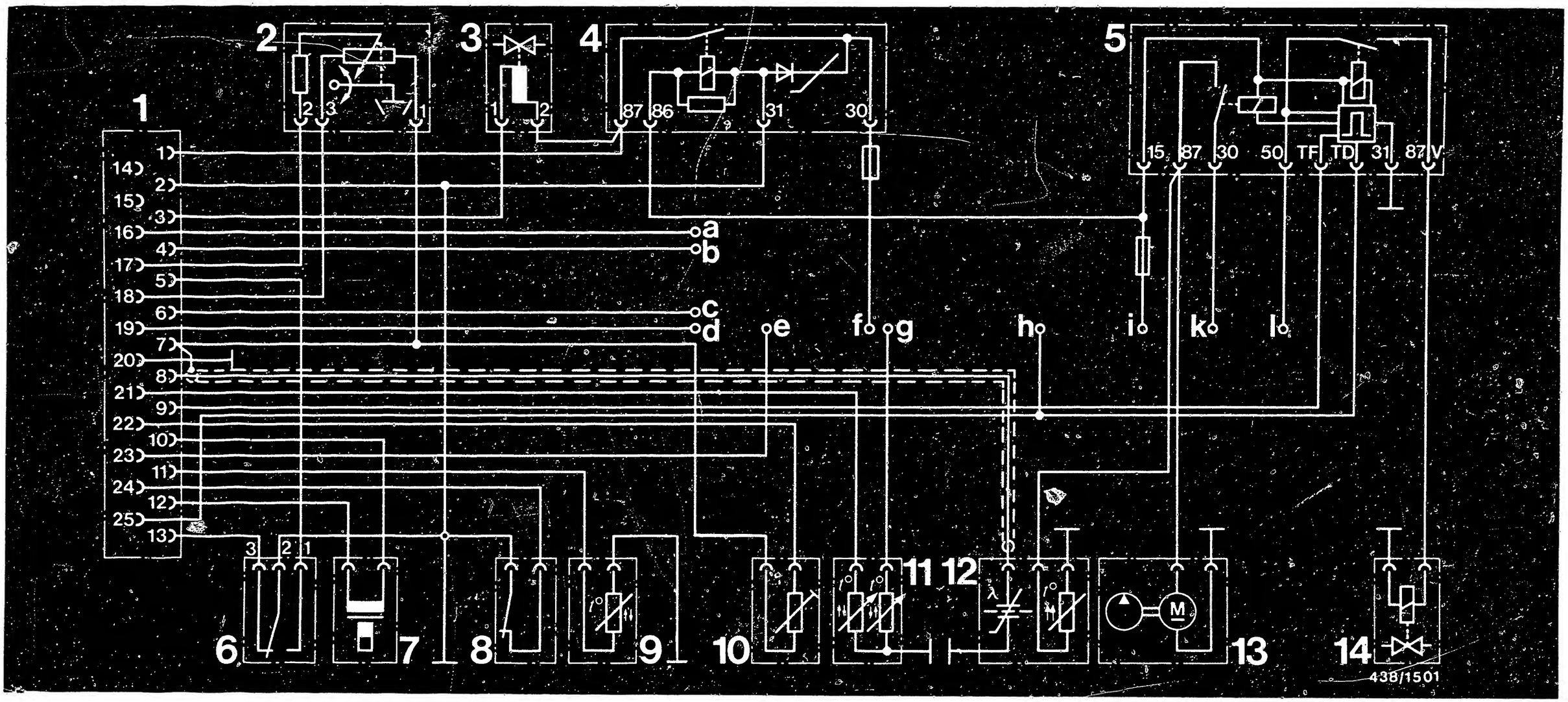


1 = Control-unit, KE-Jetronic
2 = Air-flow sensor potentiometer
3 = Idle actuator
4 = Over-voltage protection relay
5 = Electronic relay for electric fuel pump and cold-start valve actuation
6 = Throttle-valve switch, idle/full load
7 = Electro-hydraulic pressure actuator
8 = Throttle-valve switch, idle/linkage
9 = Temperature sensor, intake air (NTC I)
10 = Trimming plug, map adjustment
11 = Temperature sensor, engine (Double NTC)
12 = Heated lambda sensor
13 = Electric fuel pump
14 = Cold-start valve

ELECTRICAL TERMINAL DIAGRAM WITH ELECTRIC FUEL PUMP SAFETY CIRCUIT

B21 ⟹

B22 ⟸



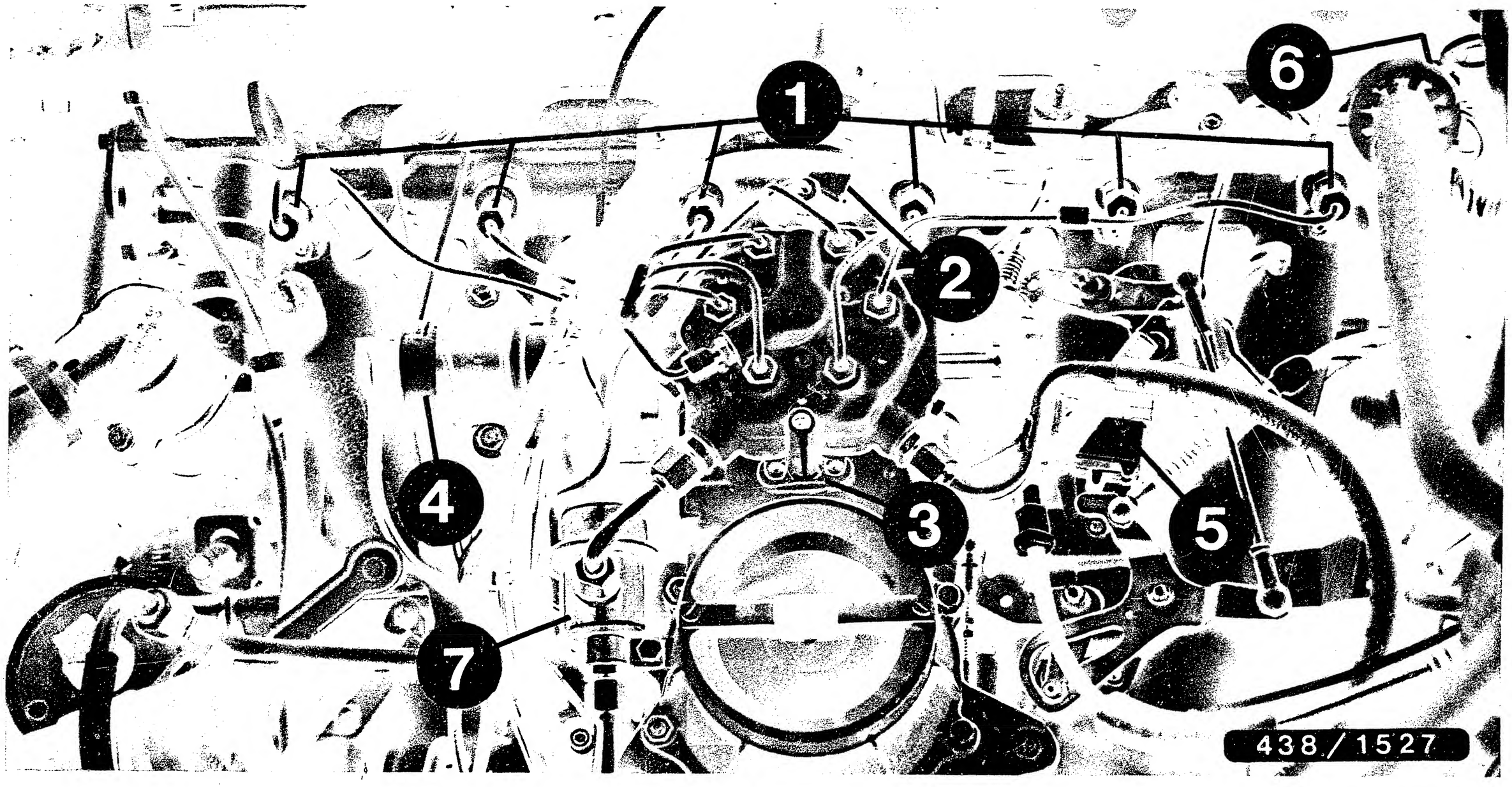
a = Transmission switch (automatic only)
b = Consumption signal
c = Connection of Tempomat operating element
d = Connection of air-conditioner control unit
e = Lambda test output

f = Terminal 30 (B +)
g = Ignition system (EZ-L)
h = TD signal, ignition
i = Terminal 15
k = Terminal 30 (B +)
l = Terminal 15a - starting motor

Electrical terminal diagram with electric fuel pump safety circuit (continued)

B23 —⟸⟹

B24 —⟸

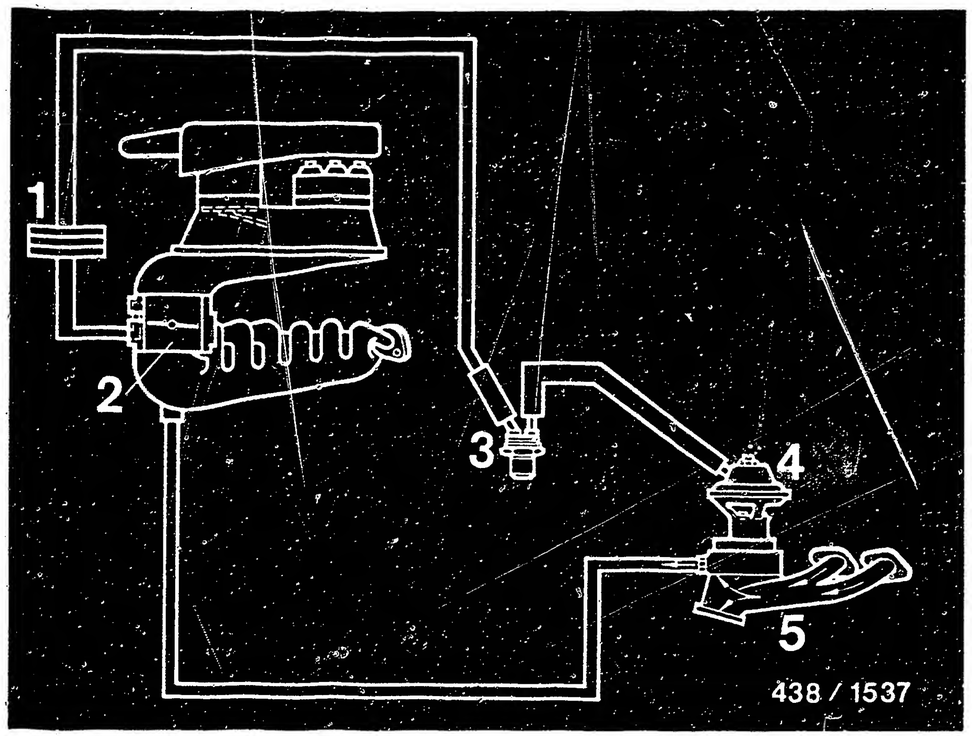


1 = Fuel-injection valves
2 = Start valve
3 = Mixture-control unit
4 = Idle actuator
5 = Throttle-valve switch, idle (microswitch on accelerator linkage)
6 = Engine-temperature sensor (concealed)
7 = Pressure regulator

INSTALLATION POSITION OF COMPONENTS

B25 — ⟹

B26 — ⟸



1 = Throttle valve
2 = Throttle-valve assembly
3 = Thermo-valve
4 = Exhaust-gas recirculation valve
5 = Exhaust manifold

IMPORTANT GENERAL INFORMATION

Exhaust-gas recirculation

Exhaust-gas recirculation (continued)

In exhaust-gas recirculation, under certain engine operating conditions some of the exhaust gases are returned to the intake tract, to take part in combustion again. This results in a reduction of peak combustion temperatures, thus reducing emissions of oxides of nitrogen (NO_x). Depending on the engine's operating condition, the amount of exhaust gas recirculated is varied, or is cut off entirely.

Exhaust-gas recirculation takes place:

* Above an engine temperature of +40°C
* In the middle and upper part-load range
* Within the part-load range, the amount of exhaust gas is determined depending on intake-manifold vacuum and the throttle-valve position.

Testing exhaust-gas recirculation:

Engine at operating temperature. Slowly increase engine speed. The exhaust-gas recirculation valve should open.

Testing the exhaust-gas recirculation valve: Connect a vacuum tester (e.g. Mityvac pump) and generate vacuum. Opening should start at about 100 mbar, with the valve fully open starting at approx. 200 mbar.

Checking the thermo-valve: Check flow-through and sealing. Vacuum inlet at the slanted fitting.

Checking throttle valve: Check flow-through and sealing. Vacuum inlet at white fitting.

Important information: Disconnect the vacuum hose from the exhaust-gas recirculation valve and seal off before idle-speed adjustment.

Trouble-shooting instructions : SAA-5002

BOSCH system : LH-Jetronic

Make of vehicle : SAAB

Basic microcard : KFZ-0..

TABLE OF CONTENTS

SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following vehicle models with 1.985 l/4-cyl. engine:

Saab 9000 i 16V 11.85->
Saab 9000 i 16V US/S/D version 05.86->
with lambda closed-loop control
Saab 900 i 16 V
05.88 ->

* LH2.2-Jetronic with 25-pin control unit: 0 280 000 530,. as of 5.87: 0 280 000 553 as of 05.88 0 280 000 567, .. 568, ..573 and 574.

* LH2.2-Jetronic with 25-pin control unit and lambda closed-loop control: 0 280 000 532

* O-ring connection technique on solenoid-operated injection valves and pressure regulator.

* Engine-speed triggering at control unit term. 1 via TD amplifier.

* Lambda closed-loop control with heated sensor.

* Mechanical throttle-valve damper.

* Knock control (APC system, Saab).

* Fuel cut-off under full-load starting.

* Low-idle-speed control by 2-winding idle speed stabilizer

* 900 i with auxiliary air regulator

* Start control

* In-tank pre-supply pump and in-tank electric fuel pump

* For testing the fuel pressure, connect pressure tester with connection piece KDJE-P 100/14 to the pressure-regulator inlet.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

* Avoid injection of fuel when testing the compression.
  To ensure this, disconnect pump relay.

For further precautionary measures, see brief instructions.

TROUBLE-SHOOTING CHART

Customer complaint (symptom of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.	2. Engine starts but then dies.	3. Rough idling (engine speed, exhaust gas).	4. Poor throttle response, flat spot during acceleration.	5. Engine misfiring (ignition, fuel injection).	6. Maximum engine power/top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
*	*	*	*	*	*	*	*		*		Universal test adapter
*											Electric fuel pump
*	*	*	*								Auxiliary-air device/idle actuator
*	*	*	*	*	*	*	*				Air-flow sensor/air-mass sensor
*	*	*	*		*						Intake system
		*	*	*		*	*				Solenoid-operated injection valves
*	*	*			*	*					Fuel pressure
				*	*						Fuel quantity
		*	*	*	*	*					Throttle valve
				*							Overrun cut-off
*		*									Start control
				*							Ground
*	*	*	*	*	*						Alternator, interference suppress.
		*	*	*		*					CO exhaust-gas adjustment
				*							Control unit
						*					Catalytic converter
		*	*	*	*						Lambda closed-loop control

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
Adapter lead: 1 684 463 141

Test step	Switch V	Switch Ω	Terminals	Testing of component/function	Test instructions/ Test conditions		Set values
1	| V	5	2 – 11	Resistance, temperature sensor (engine)	Connect adapter lead only to periphery.	+15...+30°C: approx. +80°C:	1.45...3.3 k Ω 280...360 Ω
2	| V	6	25 – 11	Frame connection of output stage			0...10 Ω
3	| V	7	5 – 11	Frame connection of sensors			0...10 Ω
4	| V	8	13 – 11	Resistance of the shunt-connected solenoid-operated injection valve and lead of the sensor heater	Disconnect sensor-heater plug and connect short-circuit wire jumper into the plug on the wiring-harness side.	+15...+30°C: approx. +80°C:	6,8...10,5 Ω 7,0...12,0 Ω
5	| V	9	3 – 11	Resistance of the idle contact	(Test of throttle-valve damper)	Accelerator pedal in rest position: Slightly depress accelerator pedal: Release accelerator pedal after approx. 3...6 s :	0...10 Ω infinity Ω 0...10 Ω
6	| V	10	12 – 11	Resistance of full-load contact		Accelerator pedal in rest position: Fully depress accelerator pedal:	infinity Ω 0...10 Ω
7	| V	10	12 – 11	Resistance of low-idle-speed control test pin	Apply test pin to ground		0...10 Ω
8	| V	11	10 – 11	(not on 900 i) Resistance of idle actuator, winding 1	Sensor-heater plug remains jumped.	+15...+30°C: approx. +80°C:	20...32 Ω 24...37 Ω

C05 ⟹

C06 ⟺

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
Adapter lead: 1 684 463 141

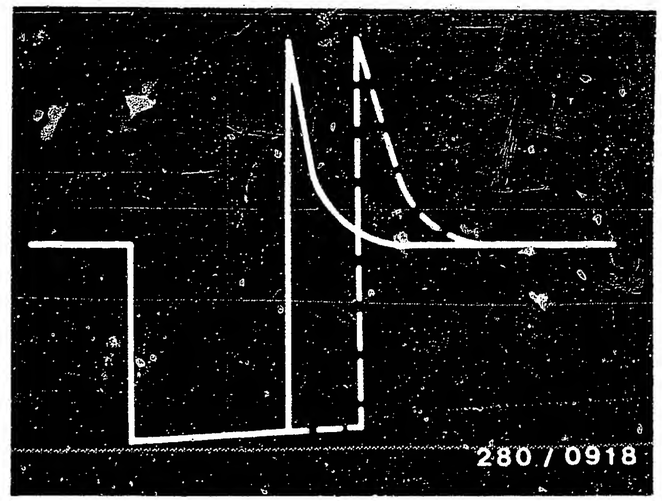
Test step	Switch V	Switch Ω	Terminals	Testing of component/function	Test instructions/ Test conditions	Set values
9	| V	12	23 – 11	(not on 900 i) Resistance of idle actuator, winding 2	Adapter lead remains connected to periphery, +15...+30°C; approx. +80°C; After test, remove jumper from sensor-heater plug and connect sensor.	18...30 Ω 22...34 Ω
10	| V	13	15 – 11	Overrun-cutoff suppression	Not applicable	
11	| V	21	14 – 6	Resistance, idle-mixture potentiometer	Dependent upon the CO adjustment	0...1100 Ω
12	5	21	1 – 11	TD signal from ignition trigger box term. 7 via TD amplifier	Transmission in neutral, start engine	Rectangular pulse on oscilloscope
13	6	21	9 – 11 (+) (–)	Voltage of main relay term. 87	Press push-button 4	8...15 V
14	7	21	18 – 11 (+) (–)	Voltage from ignition and starting switch	Ignition "ON"	8...15 V
15	8	21	21 – 11 (+) (–)	Voltage at main relay term. 85		8...15 V
16	9	21	17 – 11 (+) (–)	Voltage at pump relay term. 85 via charge-air-pressure sensing switch	Press push-button 4	8...15 V

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
Adapter lead: 1 684 463 141

Test step	Switch V	Switch Ω	Terminals	Testing of component/function	Test instructions/ Test conditions	Set values
17	10	21	16 – 11	Voltage at auxiliary-fan relay (only when air conditioner fitted)	Connect adapter lead to periphery and control unit. Leave engine running. Switch on air conditioner.	8...15 V
18	3	21	7 – 6	Output voltage, hot-wire air-mass flow sensor	Leave engine running. When engine speed changes, the output voltage must change.	2...5 V
19	11	21	22 – 11	Voltage at integrator output, lambda closed-loop control (open-loop-control value)	With catalytic converter model only. Leave engine running until at normal operating temperature.	10...13 V
20	11	22	22 – 11	Voltage at integrator output, lambda closed-loop control (rich value)	With catalytic-converter model only. Leave engine running until at normal operating temperature.	10...13 V
21	11	23	22 – 11	Voltage at integrator output, lambda closed-loop control (lean value)	With catalytic-converter model only. Leave engine running until at normal operating temperature.	Less than 0.5 V
22	11	24	22 – 11	Voltage at integrator output, lambda closed-loop control (closed-loop-control value)	With catalytic-converter model only. Leave engine running until at normal operating temperature. Take measurement at approx. 2500 min $^{-1}$.	0...13 V oscillating
23	11	24		Basic idle speed	Leave engine running until at normal operating temperature. Apply test pin (low-idle-speed control) to ground.	725...775 min $^{-1}$

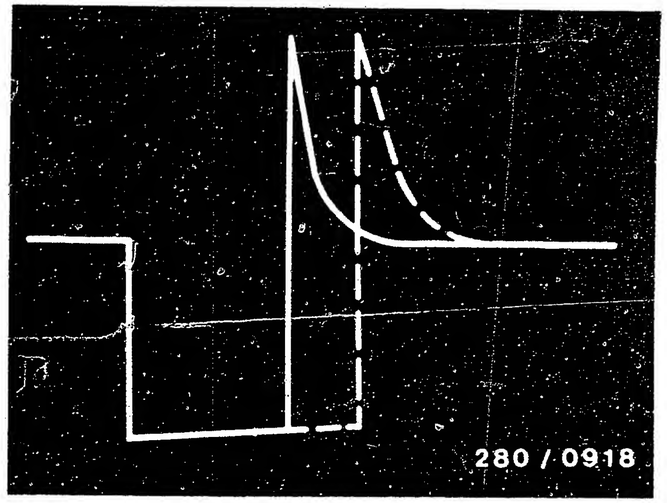
RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
Adapter lead: 1 684 463 141

Test step	Switch V	Switch Ω	Terminals	Testing of components/function Test instructions/conditions	Set values
24	11	24		(not on 900 i) On/off ratio at idle actuator Measurement with dwell-angle tester at sockets 1 and 2 Apply LFR* test pin to ground : Loosen LFR test pin from ground: In addition, switch on air conditioner (if fitted) : Accelerate; above 3000 min^{-1}, on/off ratio must increase : (*LFR = Idle mixture control.)	 29,9 % 31...33 % 34...37 % > 36 %
25	12	24	13 – 11	Injection signal t_i Leave engine running (at normal operating temperature)..	See upper illustration
26	12	24	13 – 11	Injection signal t_i Temperature sensor cold Leave engine running (at normal operating temperature). Press push-button 1. Duration of injection, engine speed and CO content become greater.	See upper illustration
27	12	24	13 – 11	Injection signal t_i Temperature sensor warm Leave engine running (at normal operating temperature). Press push-button 2. Duration of injection must remain constant.	See upper illustration



RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
Adapter lead: 1 684 463 141

Test step	Switch V	Switch Ω	Terminals	Testing of component/function Test instructions/conditions	Set values
28	12	24	13 – 11	Injection signal t_i Full-load enrichment Leave engine running (at normal operating temperature). Press push-button 6. Duration of injection, engine speed and CO content become greater.	See upper illustration
29	13	24	8 – 11	Hot-wire air-mass flow sensor, self-cleaning operation Engine must run at speed exceeding 2000 min^{-1} and the engine temperature be greater than +60° C. Then, ignition "OFF" – voltage reading after approx. 4s.	2...5 V Reading duration approx. 1s.



TEST SPECIFICATIONS

Component/function	Set values
Electric fuel pump	
* Fuel delivery at return:	at least 700 cm ^{3} /30 s
* Supply voltage under load:	at least 12 V
* Fuel delivery from pre-supply pump	at least 800 cm ^{3} /30 s
Pressure regulator	
* Fuel pressure with engine at standstill:	2,8...3,2 bar
at idle:	approx. 0.5 bar lower
at 0.5 bar charge-air pressure:	approx. 0.5 bar higher
Fuel system, leakage	
* Fuel pressure after 20 mins. with engine at standstill	at least 1.0 bar
Idle actuator	
* Resistance value at +15...+30°C between	
term. 2 and term. 3:	17...22,5 Ω
term. 2 and term. 1:	19...25,0 Ω
Temperature sensor (engine)	
* Internal electrical resistance at ambient temperature +15...+30°C:	1.45...3.3 k Ω
with engine at norm. op.temp. approx. +80°C :	280...360 Ω
Auxiliary air regulator	
* Resistance value	
0 280 140 107	40... 75 Ω
0 280 140 122	30... 65 Ω

TEST SPECIFICATIONS (Continued)

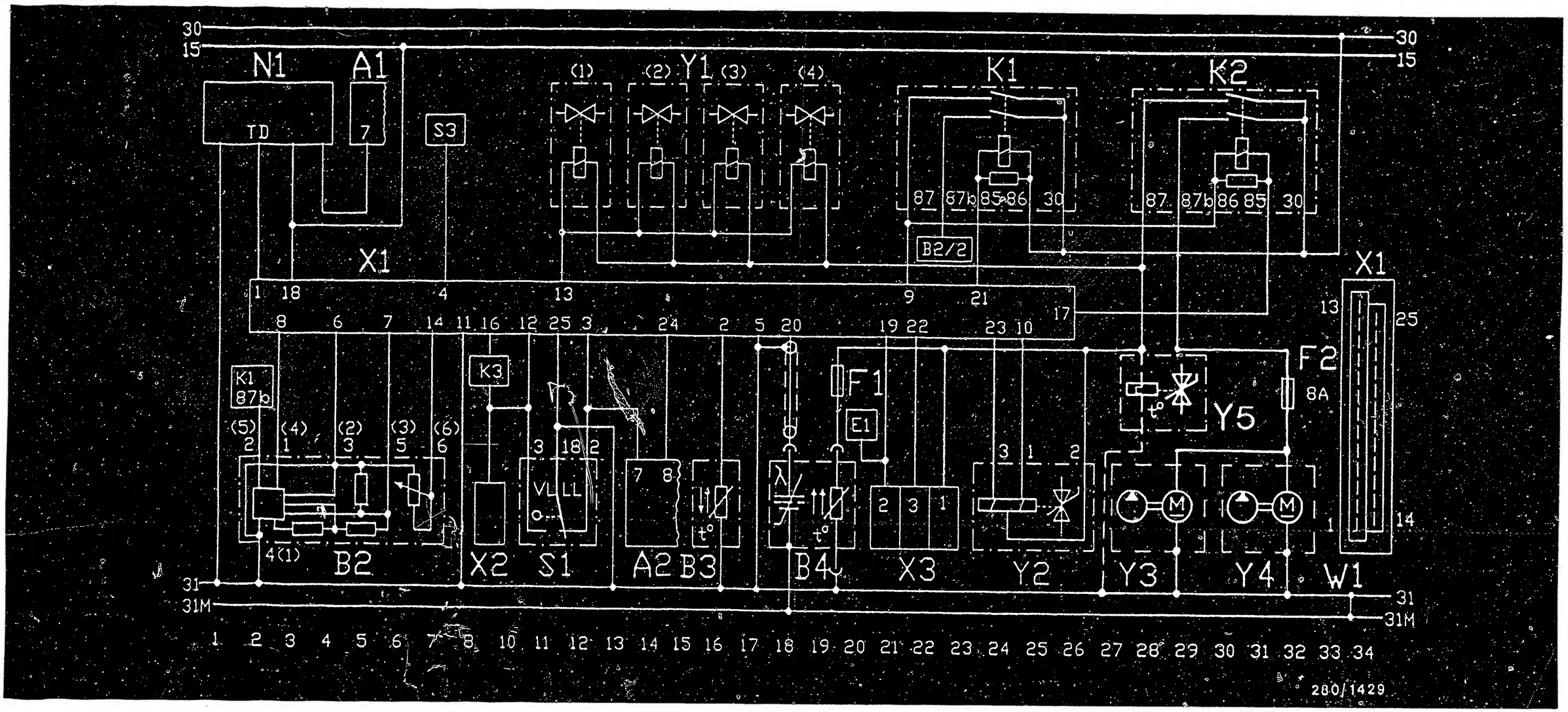
Component/function	Set values
Solenoid-operated injection valve	
* Internal electrical resistance at ambient temperature +15...+30°C:	14.5...17.0 Ω
* Leakage after 60 s:	No drop must fall
Start control	
* Voltage at injection valve on start initiation:	greater than 1.5 V
after approx. 15s:	approx. 0.5 V
Idle adjustment	
Eng. at norm. op. temp., approx. +80°C	
* Idle speed:	800...950 min $^{-1}$
with on/off ratio:	31...33 %
* Basic engine speed (test pin to ground):	725...775 min $^{-1}$
CO adjustment	Not applicable due to lambda closed-loop control
Integrator voltage	
* Closed-loop control (sensor connected must be hot) Reading fluctuates between:	0...13 V
* Open-loop control (disconnect sensor lead):	10...13 V
* Rich value (sensor lead disconnected and applied to ground at control-unit side):	10...13 V
* Lean value (apply 2 V to the sensor lead on control-unit side):	less than approx. 0.5 V

TEST SPECIFICATIONS (Continued)

Component/function	Set values
Hot-wire air-mass flow sensor	
* Resistance value with 0 280 212 009 between:	
term. 6 and term. 3:	0...1100 Ω
term. 5 and term. 3:	3.6...4.1 Ω
* Resistance value with 0 280 212 007, ..014 and ..017 between:	
term. 6 and term. 2:	0...1100 Ω
term. 3 and term. 2:	2.5...3.1 Ω
CO adjustment (on model without lambda closed-loop control)	
* At idle speed:	0,9...1,6 % by vol.
* With simulated full-load enrichment (jump term. 3 and term. 18 at throttle-valve switch):	4,0...6,0 % by vol.
Lambda sensor heating	
* Internal electrical resistance (PTC) with engine at standstill:	1...15 Ω

See equipment and Autodata microcards for setting values for valve clearance and other engine-related data.

For production reasons: continued on the following coordinate.



A1 = Ignition trigger box
A2 = Ignition control unit
B2 = Hot-wire air-mass flow sensor *
B3 = Temperature sensor (engine)
B4 = Heated lambda sensor
E1 = Limp-home indicator
F1 = Fuse (sensor heater)
F2 = Fuse (fuel pump)
K1 = Main relay
K2 = Pump relay
K3 = Auxiliary cooling-fan relay (with air conditioner)
N1 = TD amplifier
S1 = Throttle-valve switch
S3 = Drive switch (automatic)
W1 = Ground strap (engine)
X1 = Control-unit plug
X2 = Test pin (low-idle-speed control)
X3 = Test connection
1 Positive voltage, injection valve
2 Limp-home indicator
3 Integrator voltage
Y1 = Solenoid-operated injection valve
Y2 = Idle actuator (on 9000 i)
Y3 = In-tank fuel pump
Y4 = In-tank pre-supply pump
Y5 = Auxiliary air regulator (on 900 i)

* – Pin assignment without () for 0280 212 009
– Pin assignment in () for 0 280 212 007, ..014 and 017

ELECTRICAL TERMINAL DIAGRAM (lambda sensor installed only in vehicle with control unit 0 280 000 532)

C19 ⟹

C20 ⟸

INSTALLATION POSITION OF COMPONENTS

The indications "right" and "left" always refer to the forward direction of travel.
Figs. correspond to model 9000, 900 arrangement very similar.

* LH-Jetronic control unit (upper illustration, Item 1)
  On 900 behind right trim in passenger's footwell.

  The control unit is located on the left behind the engine firewall beneath a cover.
  For connecting the universal test adapter, remove control unit and disconnect control-unit plug. To do this, press open latch (locking tongue).

* Fuel-pump fuse (center illustration, No. 14).
* Safety circuit (switch on electric fuel pump for measurement), center illustration.

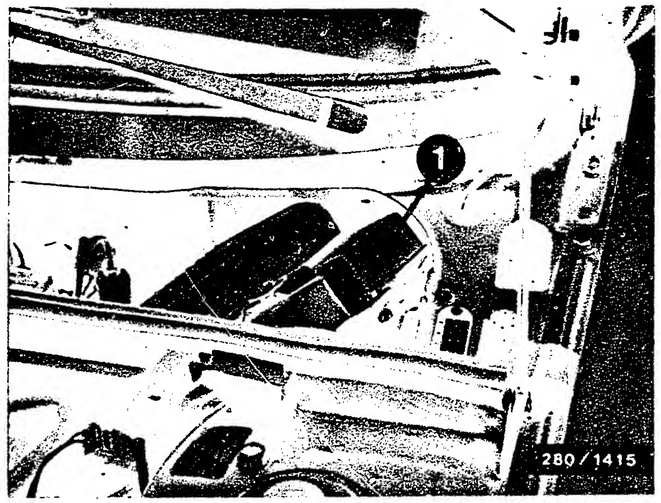
  Open glove compartment and remove cover above fuse box. Pull out fuses Nos. 14 and 22 and insert auxiliary lead (Item 1) with 8 A fuse element.

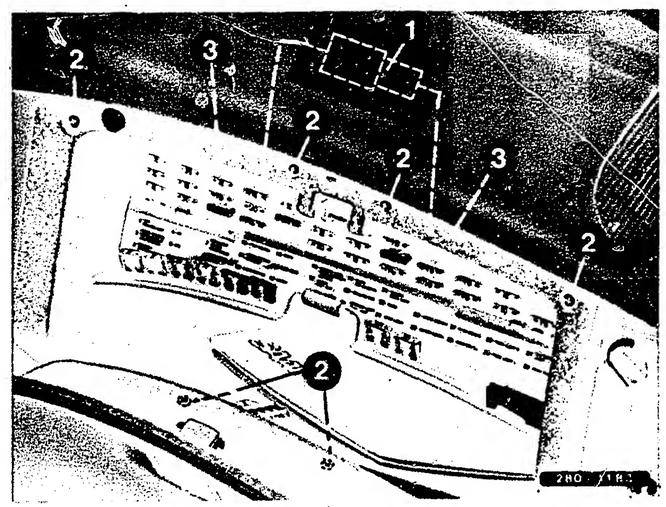
* Main and pump relays and TD amplifier (lower illustration).

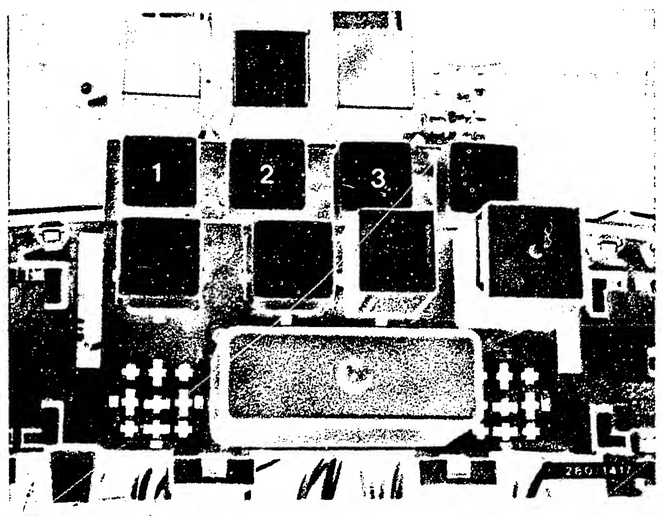
  Remove glove compartment. To do this, loosen 4 screws at top and 2 screws at bottom (center illustration, Item 2). Unlatch right-hand vent grille. Remove fuse box. Loosen screws (center illustration, Item 3). Pivot relay plate downwards.

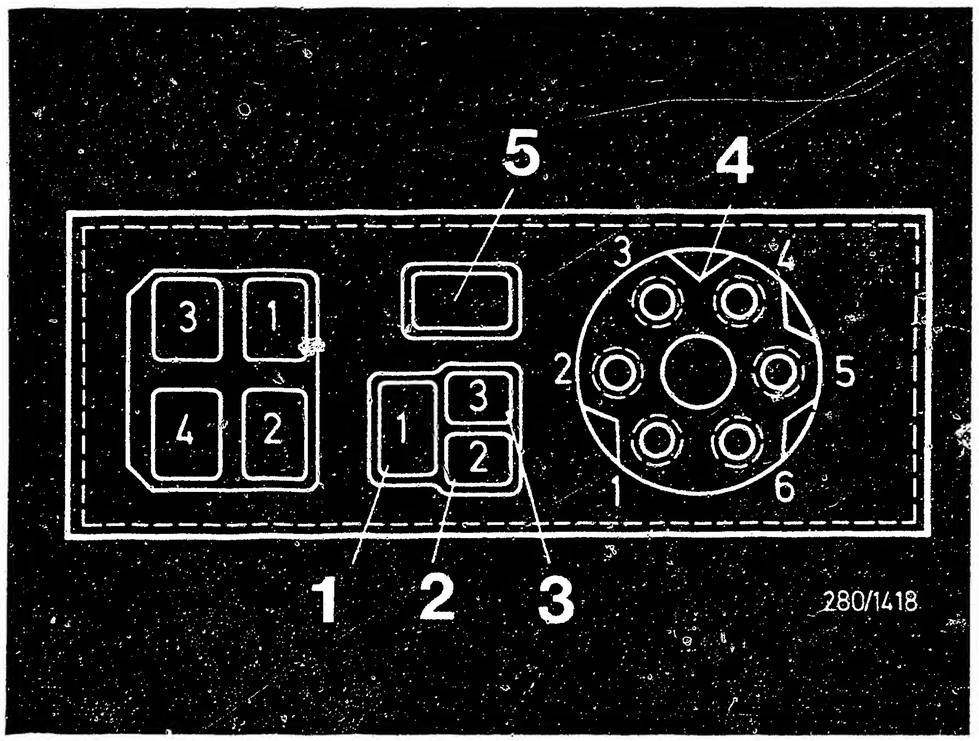
  Lower illustration:: 1 = Main relay
  2 = Pump relay
  3 = TD amplifier

On the 900 the relays are at the control unit behind the right trim in the passenger's footwell.
The fuse holder is in the engine compartment at the left wheelhouse.





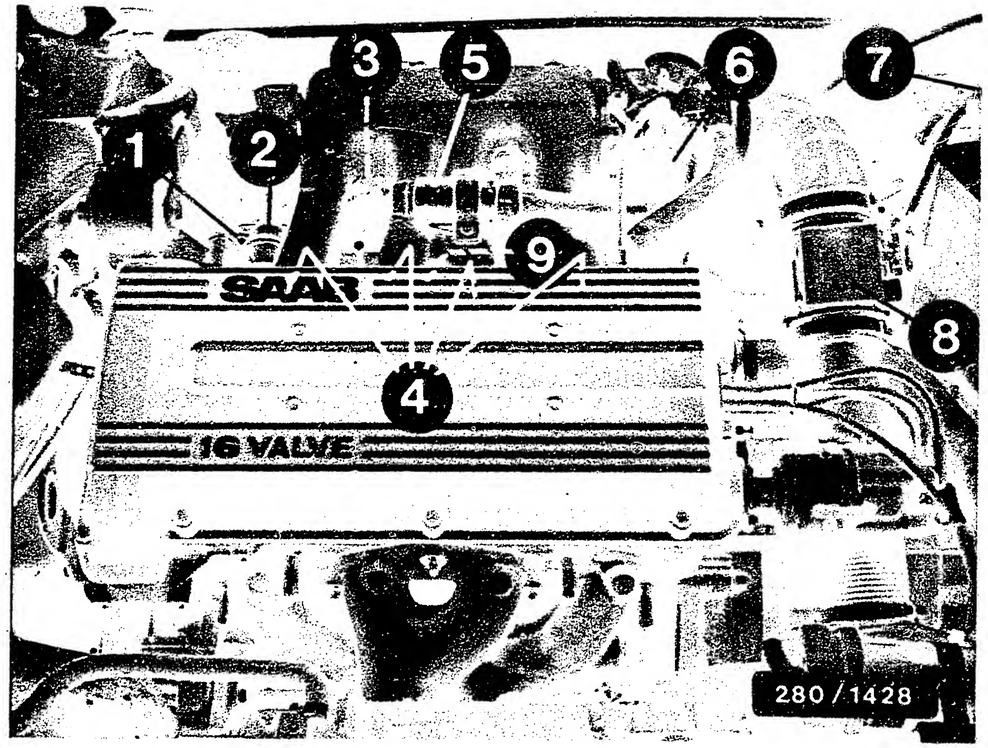




1 = Positive voltage from pump relay
2 = Limp-home indicator
3 = Integrator voltage (■)
4 = TSI socket
5 = Test pin (low-idle-speed control)

TEST CONNECTION

The connection point for the ignition-point check (TSI socket), as well as for the LH system are located together in one common test connection which is positioned in the engine compartment on the left-hand side behind the engine firewall.



1 = Ground terminals
2 = Pressure regulator
3 = Temperature sensor (engine)
4 = Solenoid-operated injection valves
5 = Idle actuator
6 = Throttle-valve switch
7 = Fuel filter
8 = Hot-wire air-mass flow sensor
9 = Knock sensor

Components on the engine

Upper illustration

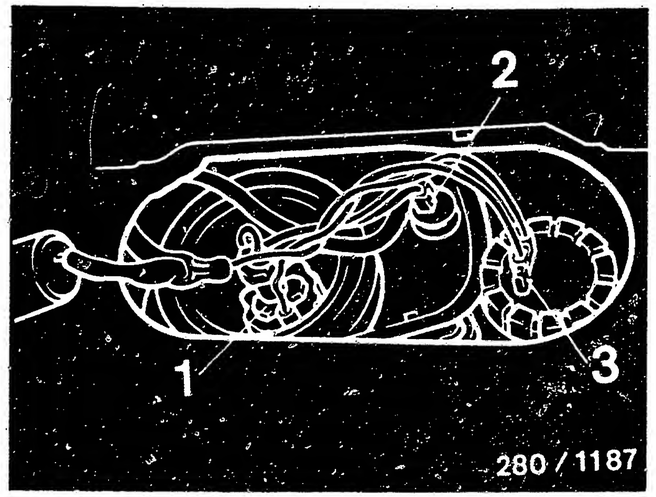
1 = In-tank electric fuel pump
2 = Electrical connection, in-tank pre-supply pump
3 = Electrical connection, fuel-level sensor

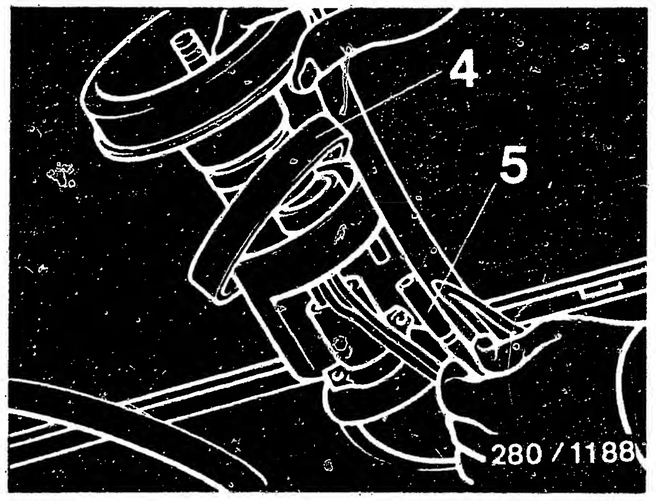
Removing the in-tank electric fuel pump

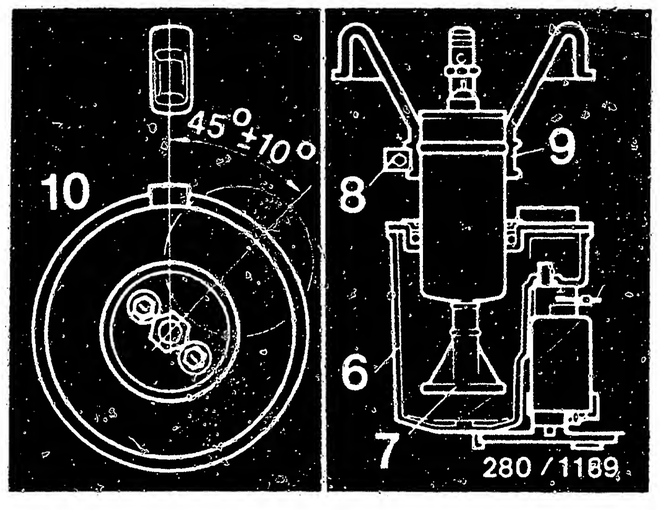
- Disconnect battery.
- Fold up rear part of the luggage-compartment floor, unscrew both fastening screws and remove the floor.
- Turn both bayonet sockets, lift up the flap and push back slightly.
- Loosen electrical connections from electric fuel pump, pre-supply pump and fuel-level sensor.
- Pinch off fuel-injection line with hose clamper.
- Unscrew inlet-union screw from the pressure connection of the electric fuel pump and pull off ring connection with fuel-injection line. Attention! Fuel may escape. Take necessary safety measures.
- Remove clamp (8) from sealing collar (9) of the electric fuel pump.
- Pull up electric fuel pump together with tank, disconnect fuel return hose from tank (5), loosen line of pre-supply pump from tank lead-through.
- Pull electric fuel pump out of tank (6) and remove strainer (7).
- Unscrew clamp (8) from sealing column (9) and pull electric fuel pump out of the collar.

Installing

- Mount sealing collar in such a way that its edge lies 50 mm above the upper edge of the fuel pump.
- Secure suction strainer (7), insert fuel pump into tank (6), position new O-ring.
- Install fuel pump in such a way that the overpressure valve of the fuel pump is offset by 45° in relation to the sealing-collar mark (10).
- Adjust overall height of the fuel pump to 250 mm.
- Proceed further in reverse sequence of steps as described under "Removing the in-tank electric fuel pump".







Further installation positions

* Grounding points for injection system
  On the engine block at the rear on the right-hand side, beneath the pressure regulator.

* Grounding point for in-tank electric fuel pump and in-tank pre-supply pump beneath the left-hand side of the rear seat bench.

* Lambda sensor in the exhaust pipe upstream of the catalytic converter.
  Plug-in connection for sensor signal and heater beneath the intake manifold.
  Fuse for sensor heater in the form of a cable fuse near to the windshield-wiper motor.

* Knock control (APC system)
  Switchgear beneath instrument panel, near to the charge-air-pressure sensing switch.
  Knock sensor on engine, beneath the intake manifold.
  Solenoid-operated valve on fan housing.
  Pressure sensor next to switchgear.
  Vacuum switch next to switchgear.

For production reasons:
continued on the following coordinate.

Trouble-shooting instructions: LAI-5001

BOSCH system : L3.2 -Jetronic

Make of vehicle : LANCIA

Basic microcard : PKW-118

SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following vehicle model:

LANCIA Y 10 1.3 i.e.
with 1.300 l / 4-cyl. engine
A, CH, D, S - versions 11.87->

* L3.2 Jetronic with 15-pole control unit: 0 280 000 610
* Engine-speed triggering from term. 1 of ignition coil.
* Control unit attached directly to air-flow sensor.
* Air-flow sensor connected to control unit via an internal 4-pole plug connection.
* CO adjusting screw on control unit.
* Actuation of electric fuel pump by control unit via pump relay.
* Supply voltage for control unit via main relay.
* Lambda closed-loop control
* Start control, i.e. additional quantity of fuel injected by way of all injection valves.
* Tank ventilation system with active-carbon container and vacuum-controlled tank ventilation valve.
* Use is to be made of pressure gauge and tubing of pressure measuring device KDJE-P 100 for testing fuel pressure.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

* Avoid injection of fuel when testing the compression.
To ensure this, disconnect pump relay.

For further precautionary measures, see brief instructions.

TROUBLE-SHOOTING CHART

Customer complaint (fault symptoms)

1. Starting motor operates, engine fails to start or starts only with difficulty.	2. Engine starts but then dies.	3. Idle problems (engine speed, exhaust gas).	4. Poor throttle take-up, flat spot during acceleration.	5. Engine missing (ignition, injection).	6. Maximum engine power/top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
*	*	*	*	*	*	*			*		Universal test adapter
*	*	*	*		*						Air-intake system
*	*	*	*								Auxiliary-air device
*		*	*	*	*	*					Air-flow sensor
				*	*						Fuel delivery
*	*	*	*		*	*	*				Fuel pressure, leaks
		*									Pump noise
		*		*	*	*	*				Solenoid-operated injection valves
				*							Alternator, interference suppression
*	*	*				*					Start control
				*		*					Overrun cutoff
		*	*	*		*					Engine-speed, CO adjustment
		*	*	*	*						Lambda closed-loop control
						*					Catalytic converter

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
Adapter lead: 1 684 463 168

Test step	Switch V	Switch Ω	Terminals	Testing of component/function	Test instructions/ Test conditions	Set values
1	V	5	8 – 5	Resistance of temperature sensor (engine)	Only connect control-unit plug Engine temperature +15...+30 °C : approx. +80 °C :	 1.45...3.3 k Ω 280...360 Ω
2	V	6	4 – 5	Ground connection of output stage		0...10 Ω
3	V	7	6 – 5	V encoding	Connect end of lead from term. 6 to ground	0...10 Ω
4	V	9	15 – 5	Throttle-valve switch/ resistance of idle contact	Throttle valve closed : Open throttle valve :	0...10 Ω infinity Ω
5	V	10	14 – 5	Throttle-valve switch/ resistance of full-load contact	Throttle valve closed : Open throttle valve completely:	infinity Ω 0...10 Ω
6	5	10	1 – 5 (+) (–)	Term. 1 signal from ignition coil term. 1	Transmission in neutral, start engine	Ignition pulses on oscilloscope
7	6	10	2 – 5 (+) (–)	Voltage supply of control unit	Switch on ignition	8...15 V
8	7	10	12 – 5 (+) (–)	Winding of pump relay	Switch on ignition	8...15 V

D05 ⟹

D06 ⟺

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)
Adapter lead: 1 684 463 168

Test step	Switch V	Switch Ω	Terminals	Testing of component/function	Test instructions/ test conditions	Set values
9	7	10	12 - 5	Simulation of electric-fuel-pump actuation	Detach connector from auxiliary-air device Switch on ignition Press test button 3	Electric fuel pump should be heard to run
9.1	7	10	12 - 5	Simulation of auxiliary-air-device actuation	Attach connector to auxiliary-air device Switch on ignition Press test button 3	Perform visual inspection to see whether air cross-section is closed off
10	7	10	12 - 5 (+) (-)	Ground actuation of pump relay term.85 by control unit	Connect up control unit Transmission in neutral, start engine Allow engine to idle	0...5 V
11	8	10	11 - 5 (+) (-)	Air-flow signal U p output term. 11	Run engine	0...5 V load-dependent
12	9	10	7 - 5 (+) (-)	Jumper from term.7 to term.2	Run engine	8...15 V
13	10	10	3 - 5 (+) (-)	Injection pulses from control unit	Run engine	Injection pulses on oscilloscope
14	11	10	10 - 5 (+) (-)	Sensor monitoring	Run engine	0...1.0 V
15	12	10	9 - 5 (+) (-)	Reference voltage U v output term. 9	Run engine	3.5...4.5 V

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)
Adapter lead :1 684 463 168

Test step	Switch V	Switch Ω	Terminals	Testing of component/function	Test instructions/ test conditions	Set values
16	10	10	3 – 5 (+) (–)	Simulation of cold engine	Run engine, press test button 1	Injection pulse wider or engine speed lower
17	10	10	3 – 5 (+) (–)	Simulation of warm engine	Run engine, press test button 2	Injection pulse must not become wider
18	10	10	3 – 5 (+) (–)	Overrun-cutoff simulation	Run engine, engine speed in excess of 2000 min^{-1} Press test button 5	No injection pulses, engine hunts
19	10	10	3 – 5 (+) (–)	Simulation of full-load correction	Run engine, engine speed approx. 2400 min^{-1} Press test button 6	Slight change in injection pulse/ engine speed
20	11	10	10 – 5 (+) (–)	Measurement output – lambda closed-loop control (mixture adjustment)	Run engine Press test button 4 Turn CO adjusting screw until voltage reading fluctuates uniformly between 0...13 V.	0...13 V fluctuating

TEST SPECIFICATIONS

Components/operation	Set values
Electric fuel pump	
* Fuel delivery at return:	at least 550 cm ^{3} /30 s
* Supply voltage under load:	at least 12V
Pressure regulator	
* Fuel pressure with engine not running:	2,3...2,7 bar
at idle speed:	approx. 0.5 bar lower
Fuel system, leakage	
* Fuel pressure 20 min. after engine switched off:	at least 1.0 bar
Auxiliary-air device	
* Internal elec. resistance:	40...75 Ω
Air-flow sensor, only measurable if control unit is removed.	
* Resistance value between term.3- and term.4- :	500...1000 Ω
term.3- and term.2- : Air-flow sensor flap in rest position	10...200 Ω
When air-flow sensor flap is deflected, indication must change:	
Temperature sensor (intake air), only measurable if control unit is removed.	
* Internal electrical resistance, between term.3- and term.1-, at ambient temperature +15...+30 °C:	1.45...3.3 k Ω

TEST SPECIFICATIONS (CONTINUED)

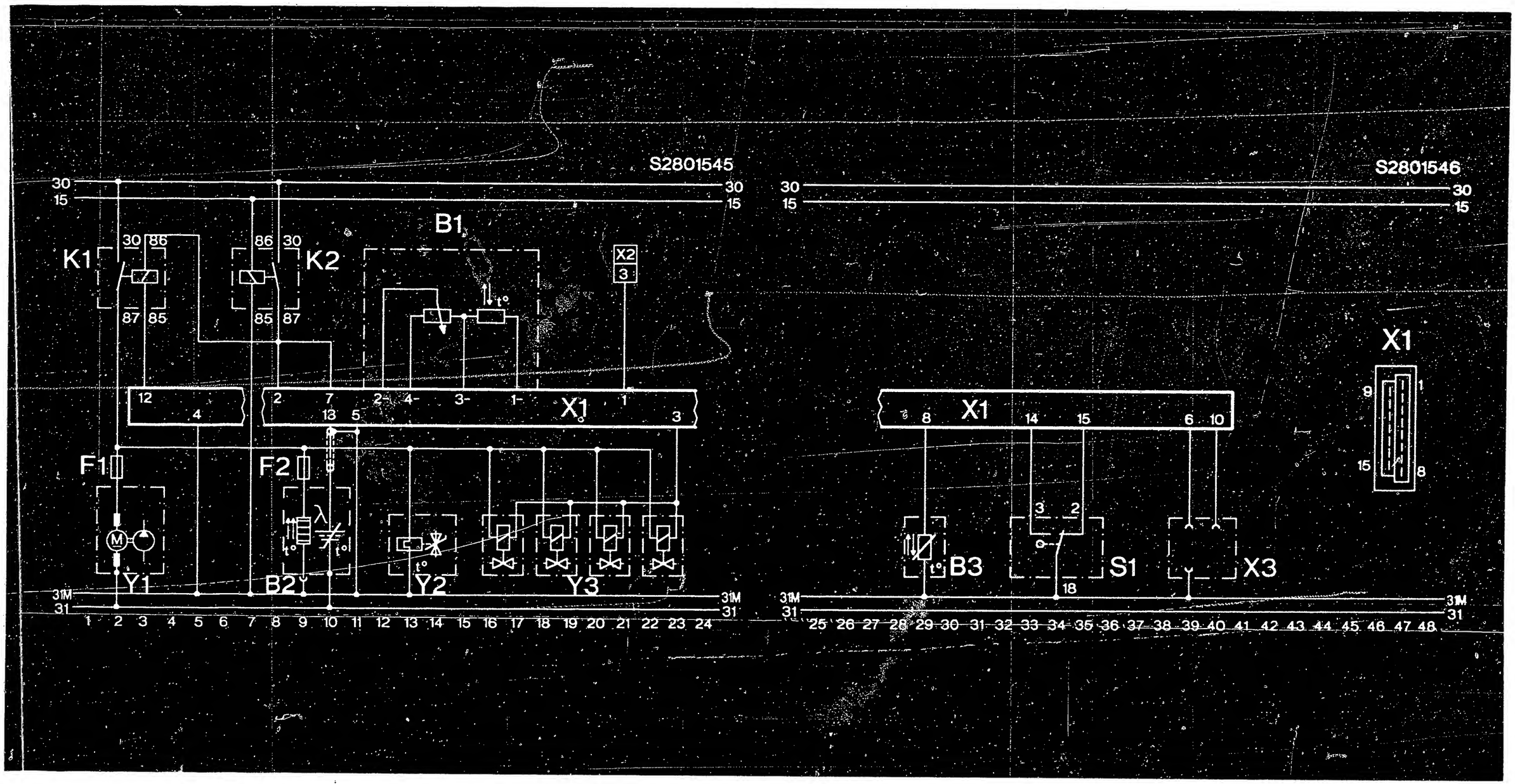
Component/function	Set values
Temperature sensor (engine)	
* Internal resistance at ambient temperature +15...+30 °C :	1.45...3.3 k Ω
with engine at operating temperature approx. +80 °C :	280...360 Ω
Solenoid-operated injection valve	
* Internal resistance at ambient temperature +15...+30 °C :	14,5...17,5 Ω
* Leakage after 60 s:	no droplet may drip off
Start control	
*Voltage at injection valve Start initiation :	approx. 1.5 V
after approx. 15s:	approx. 0.5 V
Idle-speed adjustment	
Engine at operating temperature, approx. +80°C	
* Idle speed:	800...900 min $^{-1}$

TEST SPECIFICATIONS (CONTINUED)

Component/function	Set values
CO adjustment Engine at operating temperature, approx. +80°C Short-circuit idle and full-load switch to vehicle ground (e.g. with tool KDZS 0003/0 986 618 313).	
Integrator voltage (Test pin term.10)	
* Open-loop control (disconnect plug connection of sensor lead):	Fixed voltage value between 10...13 V
* Closed-loop control (connect plug connection):	Reading fluctuates between 0...13 V
* Setting:	Reading fluctuating uniformly betw. 0...13V
* Rich value (disconnect plug connection and connect control-unit lead to ground):	10...13 V
* Lean value (apply 2V to control-unit lead):	less than approx. 1.0 V

Refer to equipment and Autodata microcard for settings as regards ignition and valve clearance as well as for other engine-related data.

For production reasons:
continued on the following coordinate.

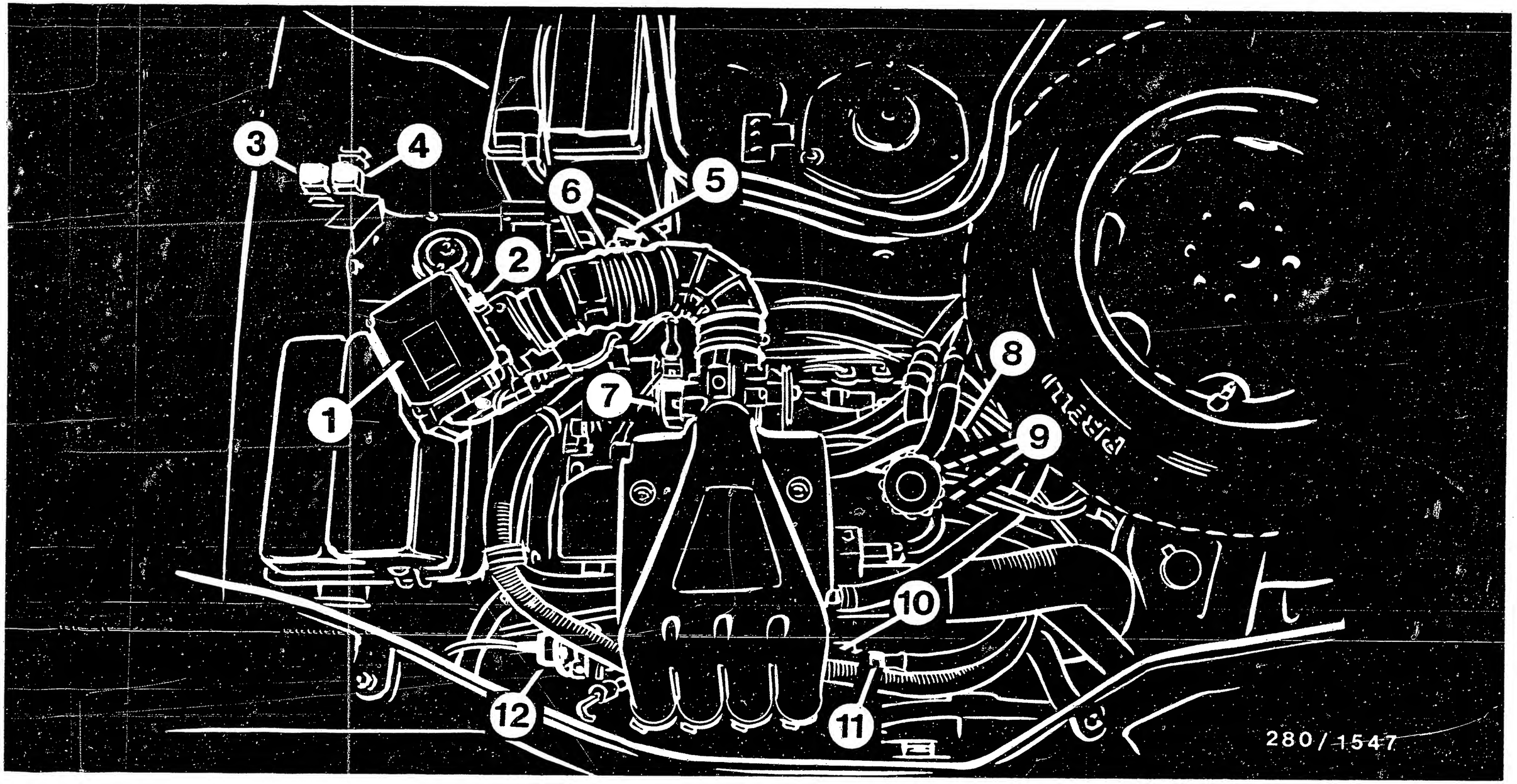


B1 = Air-flow sensor with temperature sensor (intake air)
B2 = Heated Lambda sensor
B3 = Temperature sensor (engine)
F1 = Pump fuse
F2 = Fuse for sensor heating
K1 = Pump relay
K2 = Main relay
S1 = Throttle-valve switch
X1 = Jetronic control-unit plug
X2 = Control-unit plug (ignition)
X3 = Test and encoding plug
Tm. 6 tv-encoding
Tm.10 sensor monitoring, test output
Lambda control (integrator voltage)
Y1 = Electric fuel pump
Y2 = Auxiliary air regulator
Y3 = Solenoid-operated injection valves

ELECTRICAL TERMINAL DIAGRAM

D15 ⟹

D16 ⟸

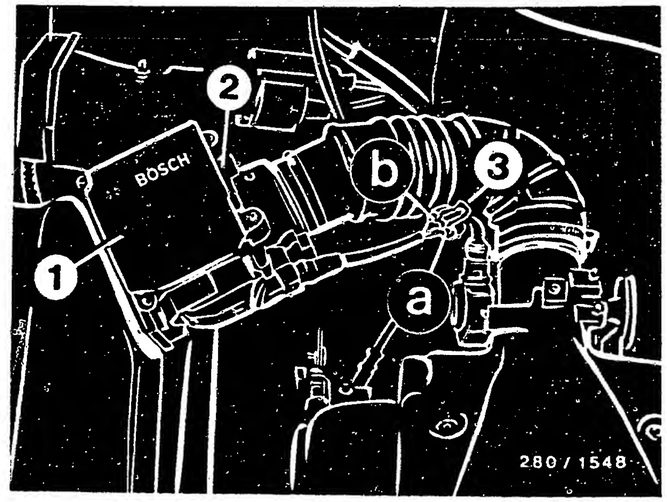


1 = Meas. and ctrl. facility consisting of air-flow sensor and ctrl. unit
2 = CO adjustment potentiometer (Lambda closed-loop control)
3 = Main relay
4 = Pump relay
5 = Plug for lambda sensor
6 = Plug for sensor heater
7 = Throttle-valve switch
8 = to auxiliary-air device
9 = to temperature sensor (engine)
10 = Solenoid-operated injection valves
11 = Pressure measurement connection
12 = Pressure regulator

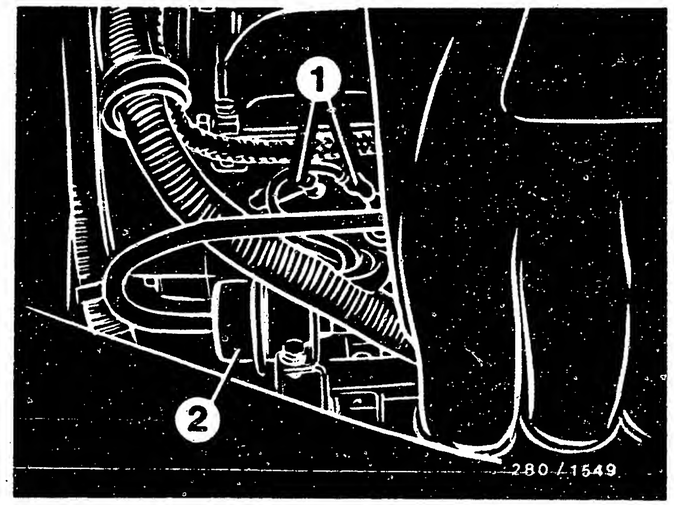
INSTALLATION POSITION OF COMPONENTS

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

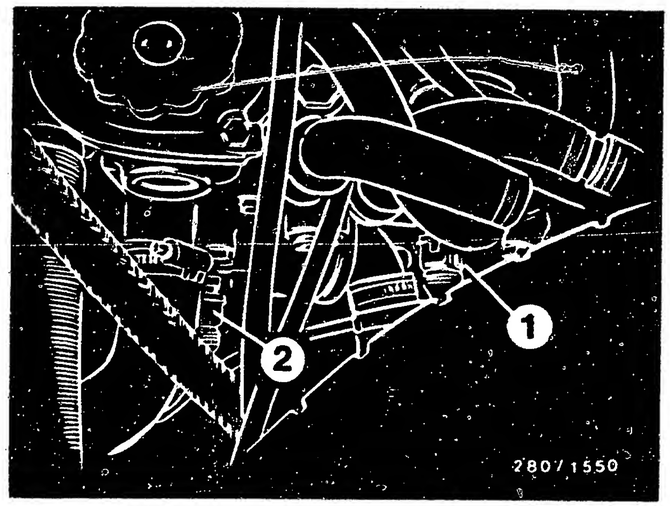
* Top picture
  1 = Measurement and control facility consisting of air-flow sensor and control unit
  2 = CO adjustment potentiometer (lambda closed-loop control)
  3 = 3-pole test connection
      a = Test pin term. 10 (integrator voltage)
      b = Connection term. 6 (t v encoding)

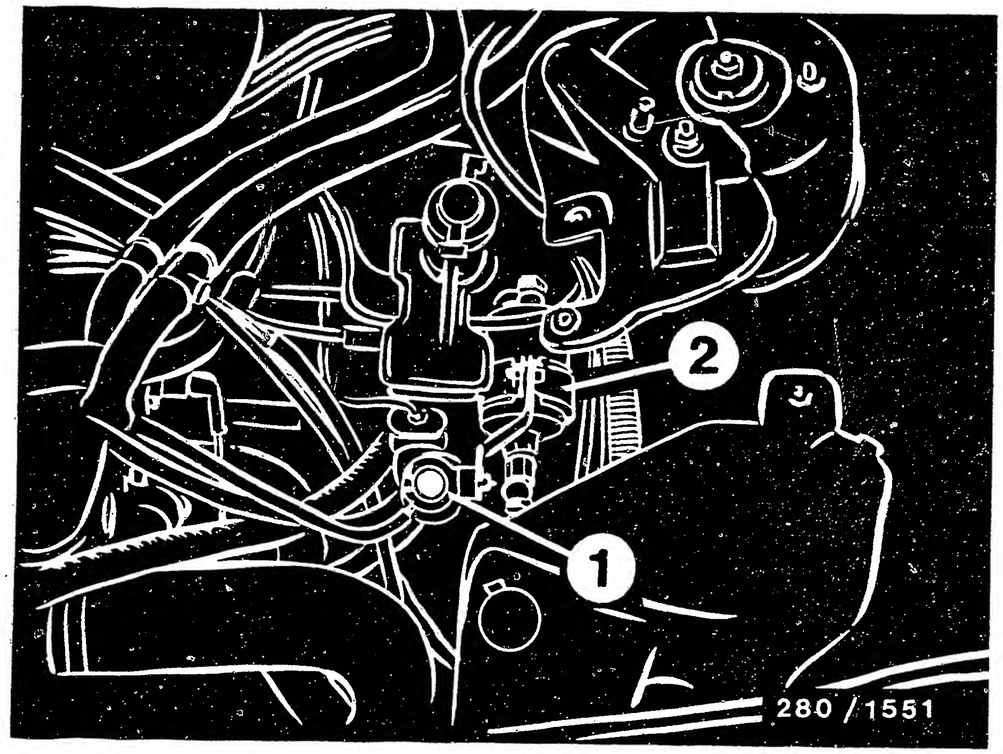


* Center picture
  1 = Central ground
  2 = Pressure regulator



* Bottom picture
  1 = Auxiliary-air device
  2 = Temperature sensor (engine)





INSTALLATION POSITION OF COMPONENTS (CONTINUED)

1 = Tank ventilation valve
2 = Fuel filter

Both components are located on the left-hand side in the engine compartment beneath the spare wheel.

The installation locations always refer to the direction of travel.

* Heated lambda sensor:
  In exhaust pipe ahead of catalytic converter.

* Active-carbon container:
  On left-hand side behind front bumper.

* Electric fuel pump is designed as an in-tank pump.

D21 — <==

For production reasons:
continued on the following coordinate.

D22 — => <=

Trouble-shooting instructions : VOL-5001

BOSCH system : LU-Jetronic

Make of vehicle : VOLVO

Basic microcard : OPE-512

TABLE OF CONTENTS

SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following vehicle models with 1.986 1/4-cyl. engine:

Volvo 360 2.0 Injection
CH/D/J version 01.86->

* LU1-Jetronic with 25-pin control unit: 0 280 000 346.
* Engine-speed triggering by term. 1 of the ignition coil.
* 5-pin air-flow sensor and 7-pin control relay.
* Solenoid-operated injection valves with brass-wire coil.
* Starting enrichment by means of cold-start valve and thermo-time switch.
* Lambda closed-loop control with heated sensor.
* No test lead from term. 22 to engine compartment for integrator-voltage measurement.
* Testing of lambda closed-loop control by CO measurement upstream of the catalytic converter.
* 3-way exhaust-gas catalytic converter
* For testing the fuel pressure, connect pressure tester with connecting piece KDJE-P 100/13 to the fuel-distribution pipe.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

* Prevent fuel from being injected during the compression test.
  For this reason, disconnect control relay.

For further precautionary measures, see basic instructions.

TROUBLE-SHOOTING CHART

Customer complaint (symptom of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.	2. Engine starts but then dies.	3. Rough idling (engine speed, exhaust gas).	4. Poor throttle response, flat spot during acceleration.	5. Engine misfiring (ignition, fuel injection).	6. Maximum engine power/top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
*	*	*	*	*	*	*	*		*		Universal test adapter
*											Electric fuel pump
*	*	*	*								Auxiliary-air device/idle actuator
*	*	*	*	*	*	*	*				Air-flow sensor/air-mass sensor
*	*	*	*		*						Intake system
		*	*	*		*	*				Solenoid-operated injection valves
*	*	*			*	*					Fuel pressure
				*	*						Fuel quantity
		*	*	*	*	*					Throttle valve
				*							Overrun cut-off
*		*									Start control
				*							Ground
*	*	*	*	*	*						Alternator, interference suppress.
		*	*	*		*					CO exhaust-gas adjustment
				*							Control unit
						*					Catalytic converter
		*	*	*	*						Lambda closed-loop control

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
Adapter lead: 1 684 463 123

Test step	Switch V	Switch Ω	Terminals	Testing of component/function	Test instructions/ Test conditions	Set values
1	5	—	1 – 5	Voltage pulses from ignition coil term. 1	Shift into neutral, start engine	Ignition pulses on oscilloscope
2	6	—	9 – 5 (+) (–)	Voltage from control relay term. 87	Shift into neutral, start engine	8...15 V
3	7	—	4 – 5 (+) (–)	Voltage from ignition and starting switch term. 50	Shift into neutral, start engine	8...15 V
4	| V	11	8 – 5	Resistor set in air-flow sensor	—	100...200 Ω
5	| V	12	7 – 5	Resistance of potentiometer in air-flow sensor	Deflect air-flow sensor flap as far as it will go.	60...1000 Ω
6	| V	13	10 – 5	Resistance, temperature sensor (engine)	+15...+30°C: Approx. +80°C:	1,45...3,3 k Ω 280...360 Ω
7	| V	14	13 – 5	Frame connection of output stage		0...10 Ω

E05 — ⟹

E06 — ⟺

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
Adapter lead: 1 684 463 123

Test step	Switch V	Switch Ω	Terminals	Testing of component/function	Test instructions/ Test conditions	Set values
8	| V	16	2 - 9	Resistance of idle contact	Accelerator pedal in rest position : Slightly depress accelerator pedal :	0...10 Ω infinity Ω
9	| V	17	3 - 9	Resistance of full-load contact	Accelerator pedal in rest position : Fully depress accelerator pedal :	infinity Ω 0...10 Ω
10	| V	18	12 - 9	Resistance of shunt-connected solenoid-operated injection valves	+15...+30°C : Approx. +80°C :	7,0...9,5 Ω 7,2...10,0 Ω

REMARK: The following components and their respective connecting leads are not covered in the test by the universal test adapter:

1. Auxiliary-air device: positive lead from term. 87 of control relay, negative lead to engine ground.
2. Electric fuel pump: positive lead from term. 87b of control relay (over pump fuse), negative lead to vehicle ground.
3. Sensor heater: positive lead from term. 87b of control relay (over sensor fuse), negative lead to engine ground.
4. Lambda sensor: sensor lead to control unit term. 20 (shielding at term. 5), sensor housing to vehicle ground.
5. Cold-start valve: positive lead from term. 50 of ignition and starting switch, negative lead to thermo-time switch term.W.
6. Thermo-time switch: at term.G, positive from term. 50 of ign.and starting switch, thermo-time-switch housing to eng. ground.

TEST SPECIFICATIONS

Component/function	Set values
Electric fuel pump	
* Fuel delivery and return:	at least 700 cm ^{3} /30 s
* Supply voltage under load:	at least 12 V
Pressure regulator	
* Fuel pressure with engine at standstill:	2,3...2,7 bar
at idle:	approx. 0.5 bar lower
Fuel system, leakages	
* Fuel pressure after 20 mins. with engine at standstill:	at least 1.0 bar
Auxiliary-air device	
* Resistance value	35...70 Ω
Air-flow sensor	
* Resistance value between	
term. 8 and term. 5:	340 ... 450 Ω
term. 7 and term. 5:	60 ...1000 Ω 1)
term. 9 and term. 5:	500 ... 760 Ω
term. 8 and term. 9:	160 ... 300 Ω
1) (Fully deflect air-flow sensor flap)	
Temperature sensor (engine)	
* Internal electrical resistance at ambient temperature +15...+30°C:	1,45...3,3 k Ω
With engine at warm. op. temp. approx. +80°C :	280...360 Ω
Lambda-sensor heater	
* Internal electrical resistance (PTC) with engine at standstill:	1...15 Ω

TEST SPECIFICATIONS (Continued)

Component/Function	Set values
Solenoid-operated injection valve	
* Internal electrical resistance at ambient temperature +15...+30°C:	14.5...17.0 Ω
* Leakage after 60 s:	no drop may fall

Thermo-time switch 35°C / 7,5 s

* Internal electrical resistance between:	Below +30°C	Above +40°C
Terminal G and ground:	25...40 Ω	50...80 Ω
Terminal W and ground:	0 Ω	100...160 Ω
Terminal G and terminal W:	25...40 Ω	50...80 Ω

Cold-start valve	
* Internal electrical resistance:	3,5...4,5 Ω
* Leakage, maximum permissible:	1 drop/min.

Idle adjustment
Engine at normal operating temperature, approx.+80°C

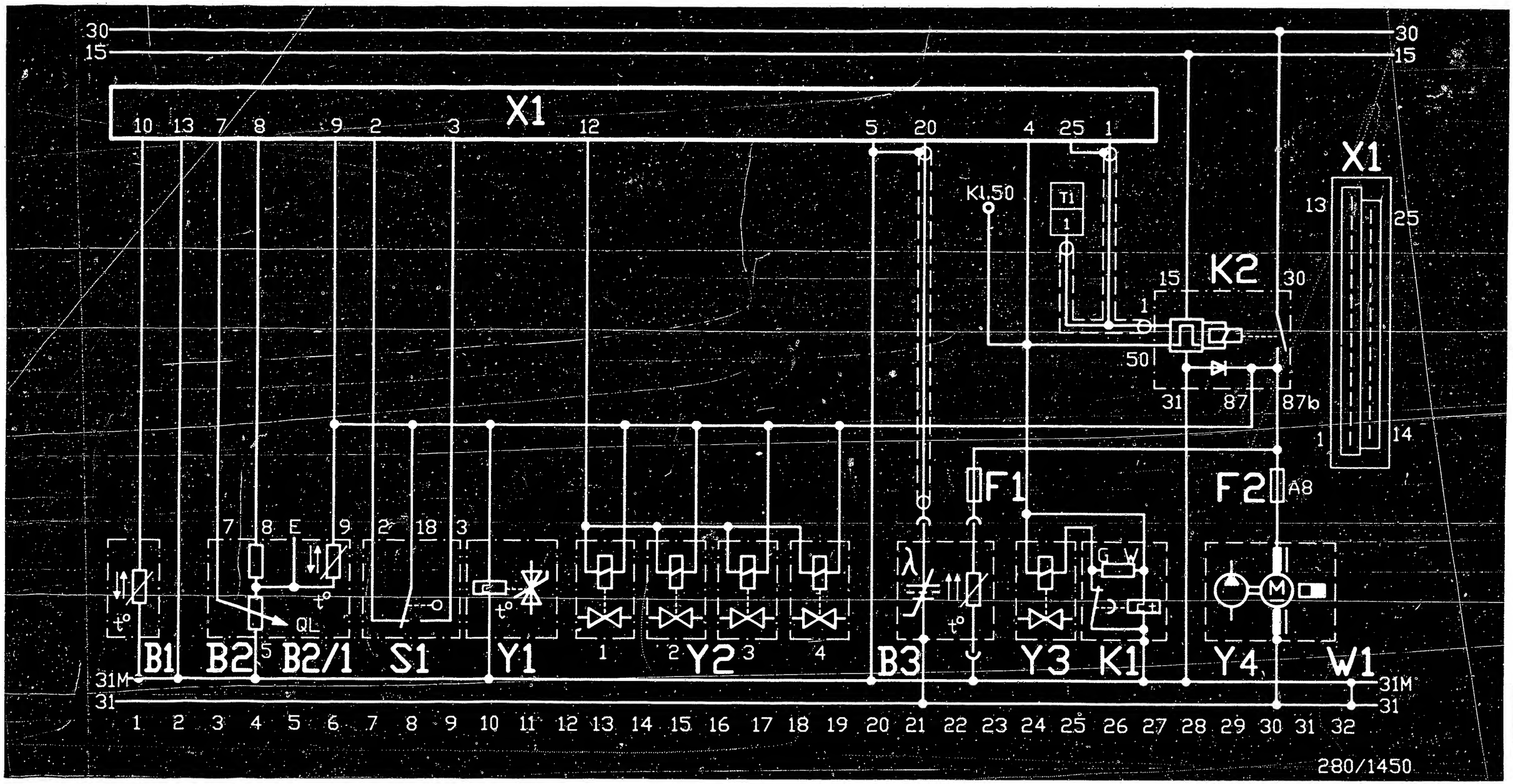
* Idle speed:	850...950 min $^{-1}$
* CO content	
Measuring point upstream of the catalytic converter, pull apart lambda-sensor plug.	
Test specification:	0,4...0,8 % by vol.
Setting:	0,6 % by vol.
Connect sensor plug:	Engine speed and CO must remain unchanged.

TEST SPECIFICATIONS (CONTINUED)

Component/function	Set values
Lambda closed-loop control Allow engine at operating temperature to idle. Detach tank-ventilation hose. Measure CO-content ahead of catalytic converter.	
* Rich value Disconnect Lambda sensor plug and connect control-unit end to ground:	CO-content increases to above 0,7 vol. %
Only perform measurement briefly.	
* Lean value Apply 2 V to control-unit end of sensor lead:	drops below 0,5 vol % Engine does not run smoothly
* Closed-loop control value Connect sensor plug. Attach tank-ventilation hose:	0,4...0,8 vol %
Detach intake-manifold pressure actuator (air hose) at pressure regulator:	briefly increases and drops back to closed-loop control value above
Switch off suction plant during exhaust-emission measurement and adjustment.	

For production reasons: continued on the following coordinate.

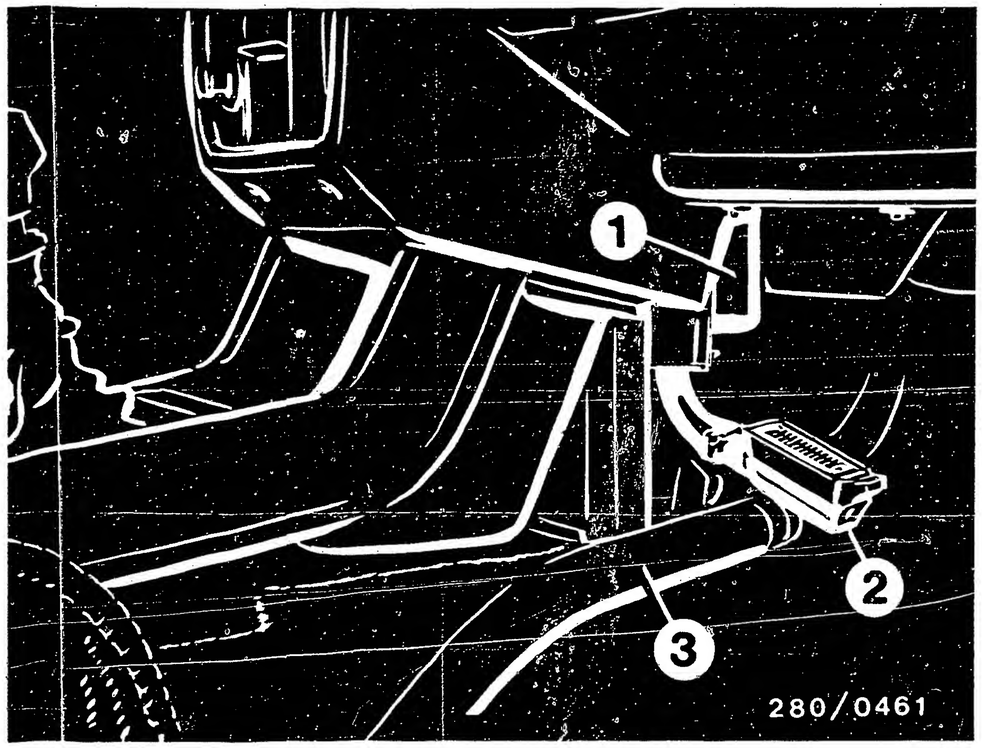
See equipment and Autodata microcards for settings as regards ignition, valve clearance and other engine-related data.



ELECTRICAL TERMINAL DIAGRAM

B1 = Temperature sensor (engine)
B2 = Air-flow sensor
B2/1= Temperature sensor (air intake)
B3 = Lambda sensor (heated)
F1 = Fuse (sensor heater)
F2 = Fuse (electric fuel pump)
K1 = Thermo-time switch
K2 = Control relay
S1 = Throttle-valve switch
W1 = Ground strap, engine
X1 = Control-unit plug
Y1 = Auxiliary-air device
Y2 = Sol.-op. injection valves
Y3 = Starting valve
Y4 = Electric fuel pump

E13 ⟹ E14 ⟸



1 = Control unit
2 = 25-pin control-unit plug
3 = Heating hose for rear-passenger-compartment heating

INSTALLATION POSITION OF COMPONENTS

The indications "right" and "left" always refer to the forward direction of travel.

* LU-Jetronic control unit in the passenger compartment.

The control unit is located transversely in the passenger compartment behind the center console.

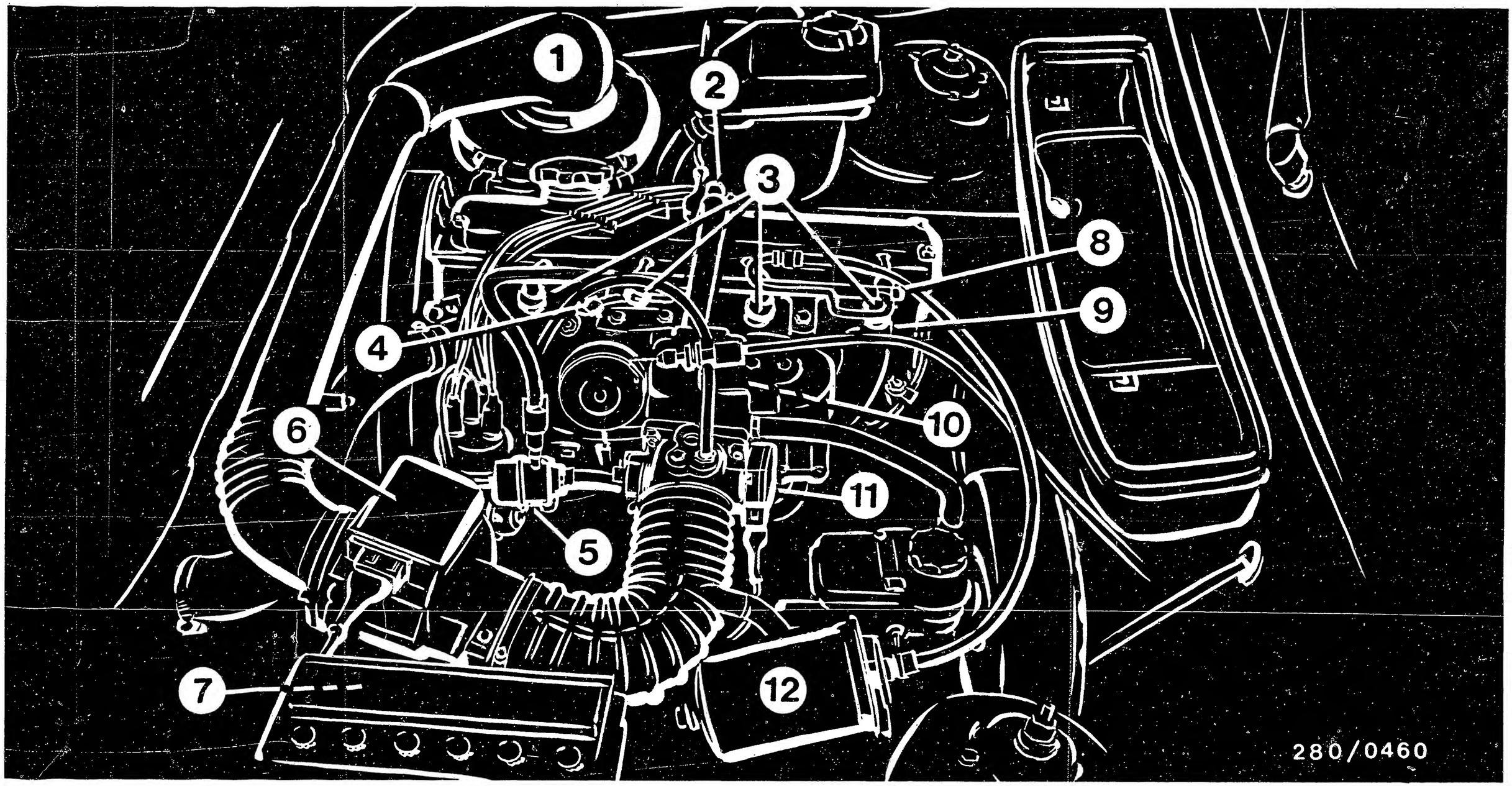
For testing electrically using the universal test adapter, push open the latch (locking tongue) and disconnect control-unit plug. Connect 25-pin adapter lead to periphery.

To remove the control unit, remove the right-hand and left-hand trim of the center console and disconnect the left-hand heating hose.
Loosen the 3 fastening screws from the control unit.

E15 ⟹

For production reasons:
continued on the following coordinate.

E16 ⟸⟹



* Layout of the components on the engine

1 = Air filter
2 = Auxiliary-air device
3 = Solenoid-operated injection valves
4 = Ground terminal (electronics and output stage)
5 = Pressure regulator
6 = Air-flow sensor
7 = Control relay
8 = Thermo-time switch
9 = Temperature sensor (engine)
10 = Cold-start valve
11 = Throttle-valve switch
12 = Fuel filter

Further installation positions of components

* Electric fuel pump is mounted on a coverplate behind the rear axle.

* Pump fuse (8A) is on the left in the engine compartment near to the battery.

* Heated lambda sensor in the exhaust pipe upstream of the catalytic converter.

* Plug-in connection for sensor signal and sensor heater upstream of the blower/heater box.

* CO sampling point at the screw plug upstream of the exhaust-gas catalytic converter.

For production reasons:
continued on the following
coordinate.

Trouble-shooting instructions : SAA-5001

BOSCH system : LH-Jetronic

Make of vehicle : SAAB

Basic microcard : KFZ-0..

TABLE OF CONTENTS

SPECIAL FEATURES

These brief instructions apply to the following vehicle models with 1.985 1/4 cyl. engine valid at the time of writing:

Saab 9000 Turbo 16V US version 05.85->
Saab 9000 Turbo 16V US/S/D/CH version 11.85->
Saab 900 Turbo 16V 05.86->

* LH2.2 Jetronic with 25-pin control unit: 0 280 000 531, as of 11.85 0 280 000 539. In 900 control unit 0 280 000 538

* Engine-speed tripping at control unit term. 1 via TD amplifier.

* Pump relay energization via charge-air-pressure monitor, triggered over 1.05 bar.

* Lambda closed-loop control with heated sensor.

* Mechanical throttle-valve damper.

* Exhaust turbo-supercharger with charge-air cooling.
* Knock control (APC system from the Saab company).
* Cutoff valve, compensates for high back pressure upstream of the hotwire air-mass sensor when the accelerator pedal is released.

* Fuel cutoff for full-load start.
* No starting information via term. 4.
* Start control
* Idle-speed control with two-winding rotary adjuster. In 900 with 1-winding rotary actuator
* In-tank pre-supply pump and in-tank electric fuel pump

* For checking fuel pressure, connect pressure measuring device with connecting part KDJE-P 100/14 at pressure-regulator inlet.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

* Avoid injection of fuel when testing the compression.
  To ensure this, disconnect pump relay.

For further precautionary measures, see brief instructions.

TROUBLE-SHOOTING CHART

Customer complaint (symptom of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Rough idling (engine speed, exhaust gas).
4. Poor throttle response, flat spot during acceleration.
5. Engine misfiring (ignition, fuel injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

1	2	3	4	5	6	7	8	9	10	11	Cause (component fault)
*	*	*	*	*	*	*	*		*		Universal test adapter
*											Electric fuel pump
*	*	*	*								Auxiliary-air device/idle actuator
*	*	*	*	*	*	*	*				Air-flow sensor/air-mass sensor
*	*	*	*		*						Intake system
		*	*	*		*	*				Solenoid-operated injection valves
*	*	*			*	*					Fuel pressure
				*	*						Fuel quantity
		*	*	*	*	*					Throttle valve
				*							Overrun cut-off
*		*									Start control
				*							Ground
*	*	*	*	*	*						Alternator, interference suppress.
		*	*	*		*					CO exhaust-gas adjustment
				*							Control unit
						*					Catalytic converter
		*	*	*	*						Lambda closed-loop control

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
Adapter lead: 1 684 463 141

Test step	Switch V	Switch Ω	Terminals	Checking of component/function	Test instructions/ test conditions		Set values
1	| V	5	2 – 11	Resistance, temperature sensor (engine)	Connect adapter lead to periphery only	+15...+30°C: approx. +80°C:	1,45...3,3 k Ω 280...360 Ω
2	| V	6	25 – 11	Ground connection of output stage			0...10 Ω
3	| V	7	5 – 11	Ground connection of sensors			0...10 Ω
4	| V	8	13 – 11	Resistance of parallel solenoid-operated injection valves and lead of sensor heating	Pull off sensor-heating plug and insert wire shorting link in plug on wiring-harness end	+15...+30°C: approx. +80°C:	6,8...10,5 Ω 7,0...12,0 Ω
5	| V	9	3 – 11	Resistance of idle contact	(Testing of throttle damper)	Accelerator at rest : Press slightly : Release after approx. 3...6 s :	0...10 Ω infinity Ω 0...10 Ω
6	| V	10	12 – 11	Resistance of full-load contact		Accelerator at rest : Floored :	infinity Ω 0...10 Ω
7	| V	10	12 – 11	Resistance of idle-control test pin	Connect test pin to ground		0...10 Ω
8	| V	11	10 – 11	Saab 9000 only Resistance of idle actuator, 2nd winding	Sensor-heating plug remains jumpered	+15...+30°C: approx. +80°C:	20...32 Ω 24...37 Ω

F05 ⟹

F06 ⟺

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
Adapter lead: 1 684 463 141

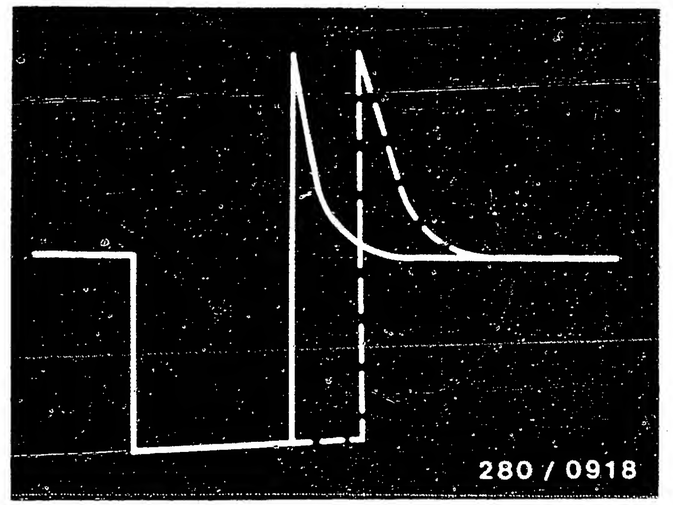
Test step	Switch V	Switch Ω	Terminals	Checking of component/function	Test instructions/ test conditions	Set values
9	| V	12	23 – 11	Saab 9000 only Resistance of idle actuator, 1st winding	Adapter lead remains connected to periphery +15...+30°C: approx. +80°C:	18...30 Ω 22...34 Ω
				Saab 900 with one-winding rotary actuator		7...17 Ω
					After testing, remove jumper at sensor-heating plug and attach sensor	
10	| V	13	15 – 11	Overrun cutoff suppression	not applicable	
11	| V	21	14 – 6	Resistance, idle-mixture potentiometer	Governed by CO setting	150...600 Ω
12	5	21	1 – 11	TD signal from igniter term. 7 via TD signal amplifier	Transmission in neutral, start engine	Rectangular pulses on oscilloscope
13	6	21	9 – 11 (+) (–)	Voltage from main relay term. 87	Press button 4	8...15 V
14	7	21	18 – 11 (+) (–)	Voltage from ignition/ starting switch	Ignition "ON"	8...15 V
15	8	21	21 – 11 (+) (–)	Voltage at main relay term. 85		8...15 V
16	9	21	17 – 11 (+) (–)	Voltage at pump relay term. 85 via boost-pressure monitor	Press button 4	8...15 V

RAPID DIAGNOISIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
Adapter cable: 1 684 463 141

Test step	Switch V	Switch Ω	Terms.	Inspection of component/function	Test instructions/ Test conditions	Set values
17	10	21	16 – 11	Voltage at auxiliary-fan relay (only with air conditioner)	Connect adapter cable to peripherals and control unit. Let engine run. Switch on air conditioner.	8...15 V
18	3	21	7 – 6	Output voltage, hot-wire air-mass sensor	Let engine run. The output voltage must change as engine speed changes.	2...5 V
19	11	21	22 – 11	Voltage at integrator output, lambda closed-loop control (open-loop control value)	Let engine run up to operating temperature.	10...13 V
20	11	22	22 – 11	Voltage at integrator output, lambda closed-loop control (rich value)	Let engine run up to operating temperature.	10...13 V
21	11	23	22 – 11	Voltage at integrator output, lambda closed-loop control (lean value)	Let engine run up to operating temperature.	less than 0.5 V
22	11	24	22 – 11	Voltage at integrator output, lambda closed-loop control (closed-loop control value)	Let engine run up to operating temperature. Conduct measurement at approx. 2500 min $^{-1}$	0...13 V oscillating
23	11	24		Basic idle speed	Let engine run up to operating temperature. Connect test pin (idle-speed control) to ground.	725...775 min $^{-1}$

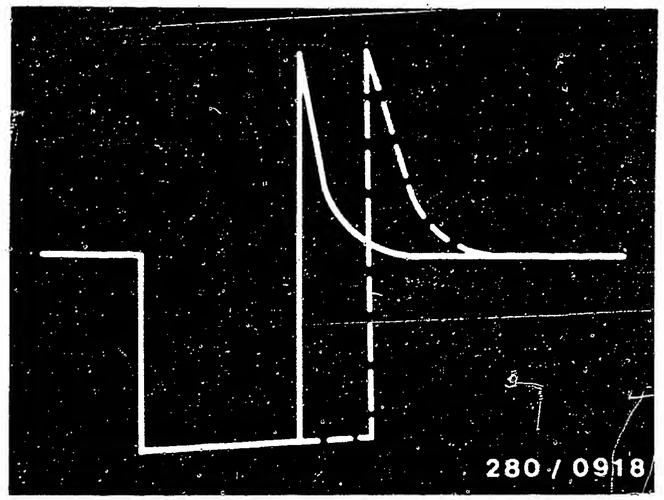
RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
Adapter lead: 1 684 463 141

Test step Switch V	Test step Switch Ω	Terminals	Testing of components/function Test instructions/conditions	Set values
24	24		(not on 900 i) On/off ratio at idle actuator Measurement with dwell-angle tester at sockets 1 and 2 Apply LFR* test pin to ground : Loosen LFR test pin from ground: In addition, switch on air conditioner (if fitted) : Accelerate; above 3000 min^{-1}, on/off ratio must increase : (*LFR = Idle mixture control.)	 29,9 % 31...33 % 34...37 % > 36 %
25	24	13 - 11	Injection signal t_i Leave engine running (at normal operating temperature)..	See upper illustration
26	24	13 - 11	Injection signal t_i Temperature sensor cold Leave engine running (at normal operating temperature). Press push-button 1. Duration of injection, engine speed and CO content become greater.	See upper illustration
27	24	13 - 11	Injection signal t_i Temperature sensor warm Leave engine running (at normal operating temperature). Press push-button 2. Duration of injection must remain constant.	See upper illustration



RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
Adapter lead: 1 684 463 141

Test step	Switch V	Switch Ω	Terminals	Testing of component/function Test instructions/conditions	Set values
28	12	24	13 – 11	Injection signal t_i Full-load enrichment Leave engine running (at normal operating temperature). Press push-button 6. Duration of injection, engine speed and CO content become greater.	See upper illustration
29	13	24	8 – 11	Hot-wire air-mass flow sensor, self-cleaning operation Engine must run at speed exceeding 2000 min^{-1} and the engine temperature be greater than +60° C. Then, ignition "OFF" – voltage reading after approx. 4s.	2...5 V Reading duration approx. 1s.



TEST SPECIFICATIONS

Component/function	Set values
Electric fuel pump	
* Delivery at return:	min. 900 cm ^{3} /30 s
* Supply voltage under load:	min. 12 V
* Delivery of pre-supply pump	min. 1000 cm ^{3} /30 s
Pressure regulator	
* Fuel pressure	
with engine stopped:	2,3...2,7 bar
idling:	approx. 0.5 bar less
at 0.5 bar boost pressure:	approx. 0.5 bar more
Fuel system, leakage	
* Fuel pressure after engine stopped for 20 min.:	min. 1.0 bar
Idle actuator (Saab 900)	
* Resistance at +15...+30°C between	
Term. 2 and term. 3:	17...22,5 Ω
Term. 2 and term. 1:	19...25,0 Ω
* (Saab 900)	7...10,0 Ω
Hot-wire air-mass meter	
* Resistance between	
Term. 6 and term. 3:	0...1100 Ω
Term. 5 and term. 3:	3,6...4,1 Ω
Temperature sensor (engine)	
* Internal resistance at ambient temperature	
+15...+30°C:	1.45...3.3 k Ω
with warm engine approx. +80°C :	280...360 Ω

TEST SPECIFICATIONS (Continued)

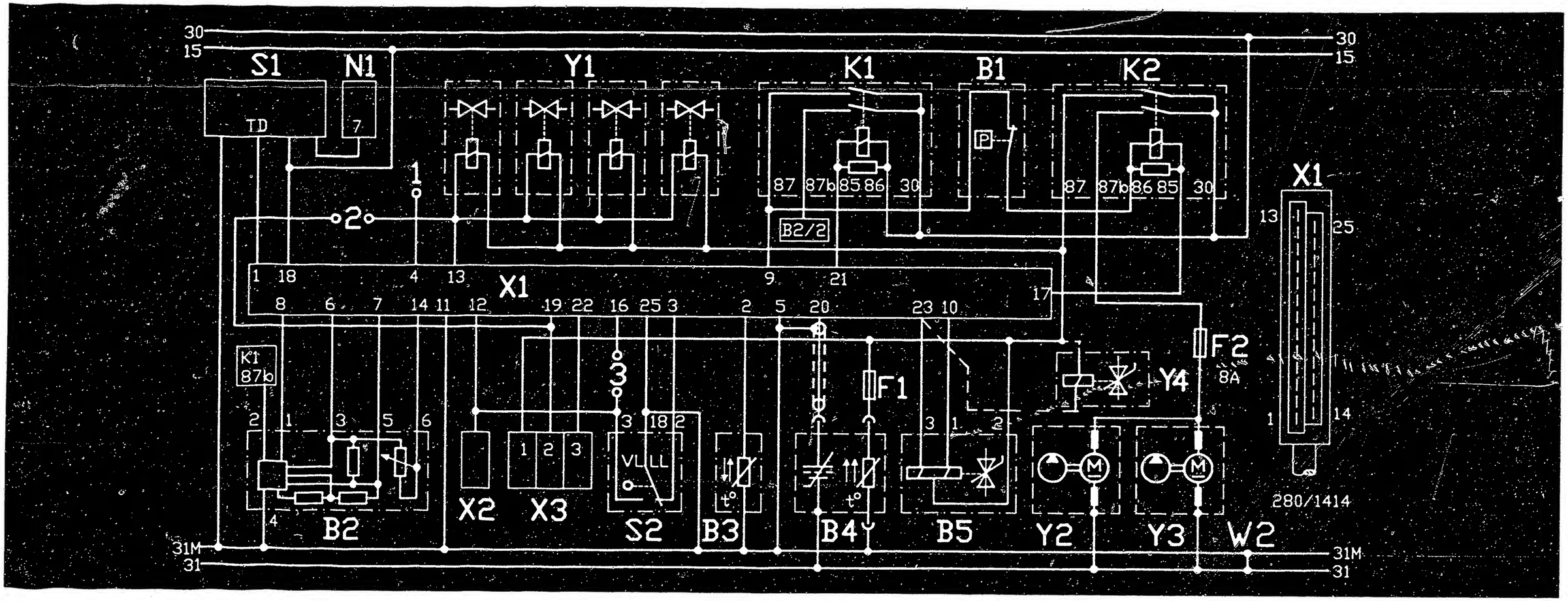
Component/function	Set values
Solenoid-operated injection valve	
* Internal electrical resistance at ambient temperature +15...+30°C:	14.5...17.0 Ω
* Leakage after 60 s:	No drop must fall
Start control	
* Voltage at injection valve	
on start initiation:	greater than 1.5 V
after approx. 15s:	approx. 0.5 V
Idle adjustment	
Eng. at norm. op. temp., approx. +80°C	
* Idle speed:	800...950 min $^{-1}$
with on/off ratio:	31...33 %
* Basic engine speed (test pin to ground):	725...775 min $^{-1}$
CO adjustment	Not applicable due to lambda closed-loop control
Integrator voltage	
* Closed-loop control (sensor connected must be hot) Reading fluctuates between:	0...13 V
* Open-loop control (disconnect sensor lead):	10...13 V
* Rich value (sensor lead disconnected and applied to ground at control-unit side):	10...13 V
* Lean value (apply 2 V to the sensor lead on control-unit side):	less than approx. 0.5 V

TEST SPECIFICIATIONS (continued)

Component/function	Set values
Exhaust turbo-supercharger	
* Max. charge-air pressure:	0,7...0,8 bar
* Basic charge-air pressure:	0,32...0,38 bar
* Pressure monitor (switching pressure)	0,9...1,0 bar
Lambda sensor heater	
* electrical internal resistance (PTC) with engine stopped:	1...15 Ω

For setting values for ignition, valve clearance and other technical engine data, see equipment and autodata microcard.

For production reasons:
continued on the following coordinate.



ELECTRICAL TERMINAL DIAGRAM

B1 = Charge-air-pressure monitor
B2 = Hot-wire air-mass sensor
B3 = Temperature sensor (engine)
B4 = Heated lambda sensor
B5 = Idle actuator (Saab 9000)
F1 = Fuse, sensor heater
F2 = Fuse, fuel pumps
K1 = Main relay
K2 = Pump relay
N1 = Ignition trigger box
S1 = TD amplifier
S2 = Throttle-valve switch
W2 = Ground-strap, engine
X1 = Control-unit plug
X2 = Test pin (idle-speed control)
X3 = Test connection
1 Positive voltage from pump relay
2 Limp-home indication
3 Integrator voltage (1)
Y1 = Solenoid-operated injection valves
Y2 = In-tank fuel pump
Y3 = In-tank pre-supply pump
Y4 = Idle actuator (Saab 900)
1 = Drive switch (automatic)
2 = to vehicle computer
3 = Auxiliary fan relay (with air conditioner)

INSTALLATION POSITION OF COMPONENTS

The indications "right" and "left" always refer to the forward direction of travel.
Figs. correspond to model 9000, 900 arrangement very similar.

* LH-Jetronic control unit (upper illustration, Item 1)
  On 900 behind right trim in passenger's footwell.

  The control unit is located on the left behind the engine firewall beneath a cover.
  For connecting the universal test adapter, remove control unit and disconnect control-unit plug. To do this, press open latch (locking tongue).

* Fuel-pump fuse (center illustration, No. 14).
* Safety circuit (switch on electric fuel pump for measurement), center illustration.

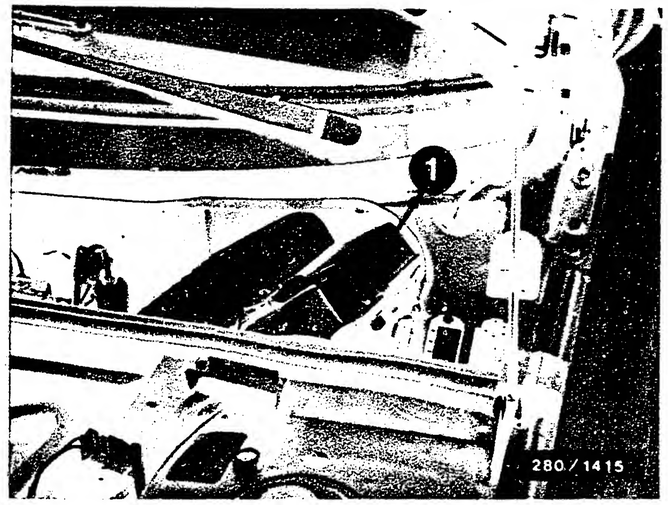
  Open glove compartment and remove cover above fuse box. Pull out fuses Nos. 14 and 22 and insert auxiliary lead (Item 1) with 8 A fuse element.

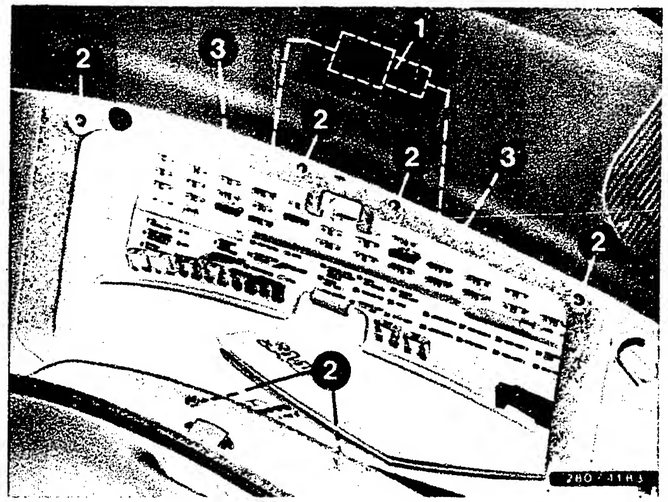
* Main and pump relays and TD amplifier (lower illustration).

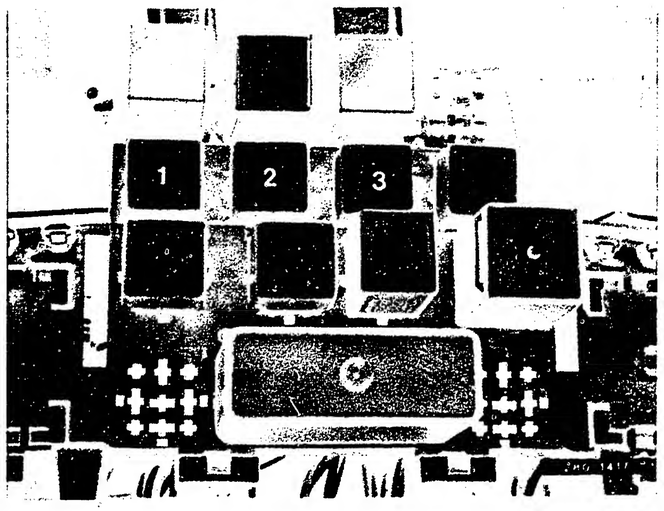
  Remove glove compartment. To do this, loosen 4 screws at top and 2 screws at bottom (center illustration, Item 2). Unlatch right-hand vent grille. Remove fuse box. Loosen screws (center illustration, Item 3). Pivot relay plate downwards.

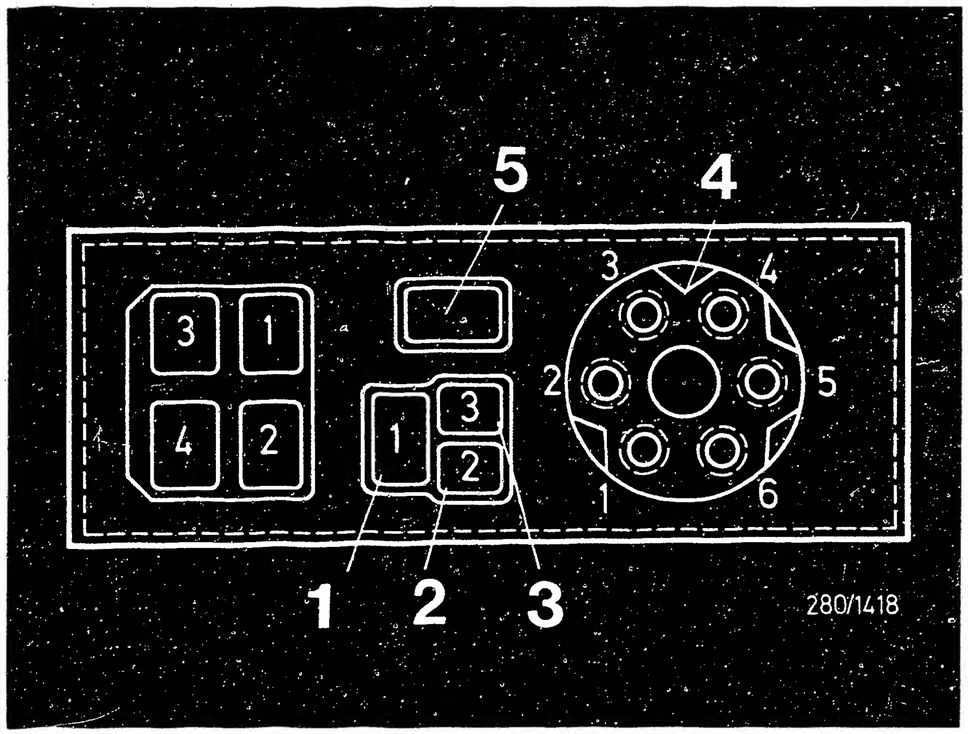
  Lower illustration:: 1 = Main relay
  2 = Pump relay
  3 = TD amplifier

On the 900 the relays are at the control unit behind the right trim in the passenger's footwell.
The fuse holder is in the engine compartment at the left wheelhouse.









1 = Positive voltage from pump relay
2 = Limp-home indicator
3 = Integrator voltage (■)
4 = TSI socket
5 = Test pin (low-idle-speed control)

TEST CONNECTION

The connection point for the ignition-point check (TSI socket), as well as for the LH system are located together in one common test connection which is positioned in the engine compartment on the left-hand side behind the engine firewall.

Further installation positions

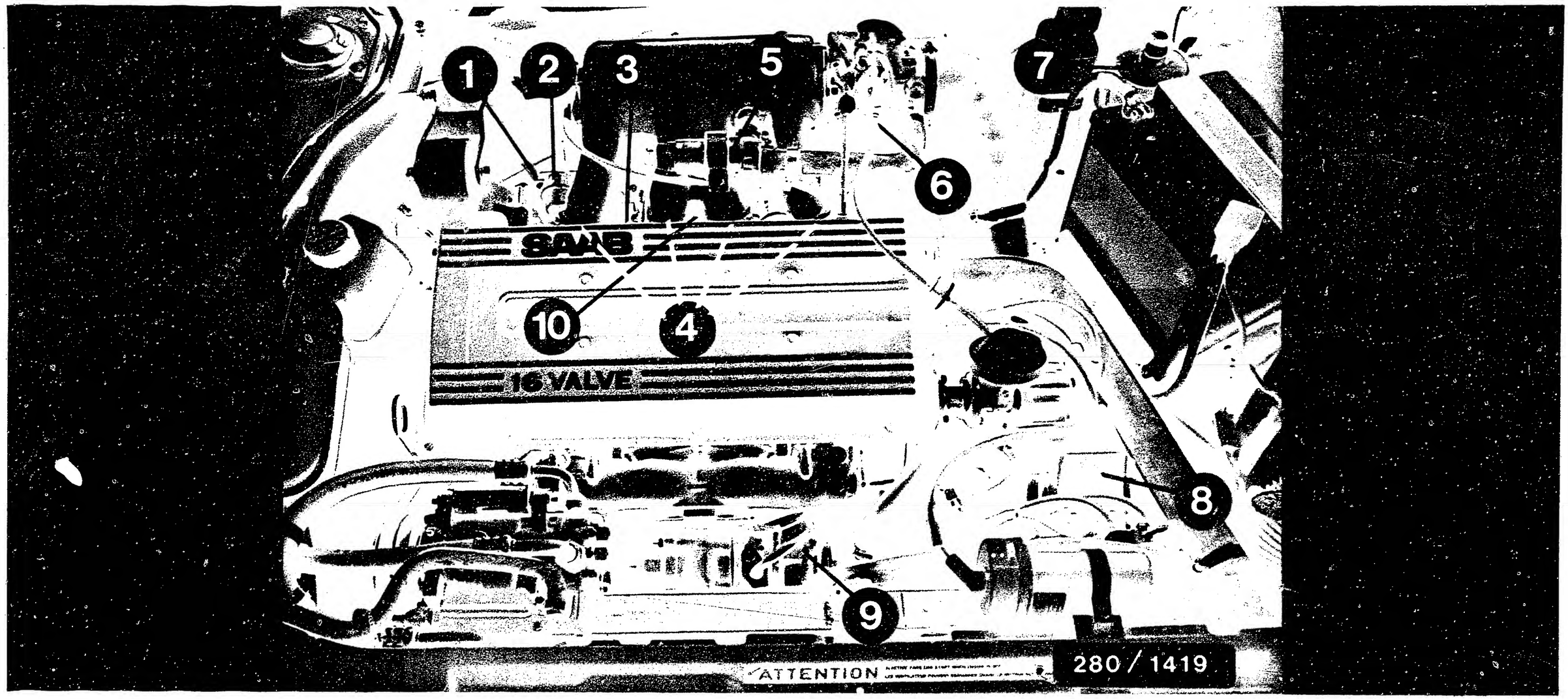
* Ground points for injection system
  On engine block at rear on right, beneath the pressure regulator.

* Ground point for in-tank electric fuel pump and fuel-supply pump beneath left-hand section of rear seat.

* Lambda sensor in exhaust pipe ahead of catalytic converter.
  Plug-in connection for sensor signal and heater beneath the intake manifold.
  Fuse for sensor heater in form of cable fuse close to windscreen wiper motor.

* Charge-air-pressure monitor beneath the instrument panel, on left next to steering column (beneath the knee protector). Over 1.05 bar charge-air pressure, switches the electric fuel pump off.

* Knock control (APC system)
  Trigger box beneath instrument panel, close to charge-air-pressure monitor.
  Knock sensor on engine, beneath intake manifold.
  Solenoid-operated valve on fan housing.
  Pressure sensor next to trigger box.
  Vacuum-operated switch next to trigger box.



Components on the engine

1 = Ground terminals
2 = Pressure regulator
3 = Temperature sensor (engine)
4 = Solenoid-operated injection valves
5 = Idle adjuster
6 = Throttle-valve switch
7 = Fuel filter
8 = Hot-wire air-mass sensor
9 = Exhaust turbo-supercharger
10 = Knock sensor

Upper illustration

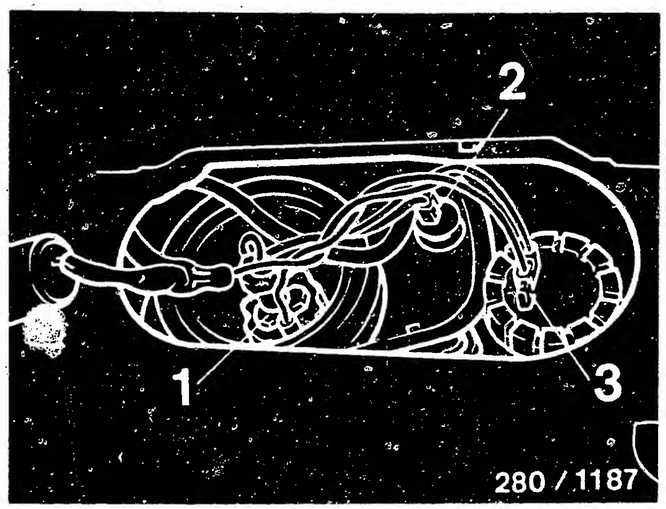
1 = In-tank electric fuel pump
2 = Electrical connection, in-tank pre-supply pump
3 = Electrical connection, fuel-level sensor

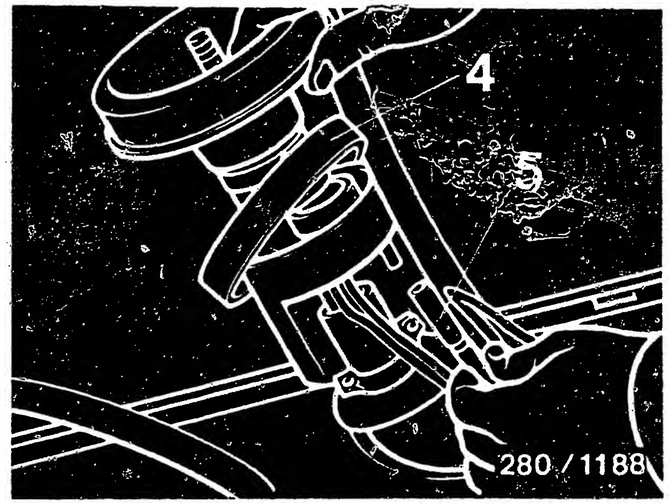
Removing the in-tank electric fuel pump

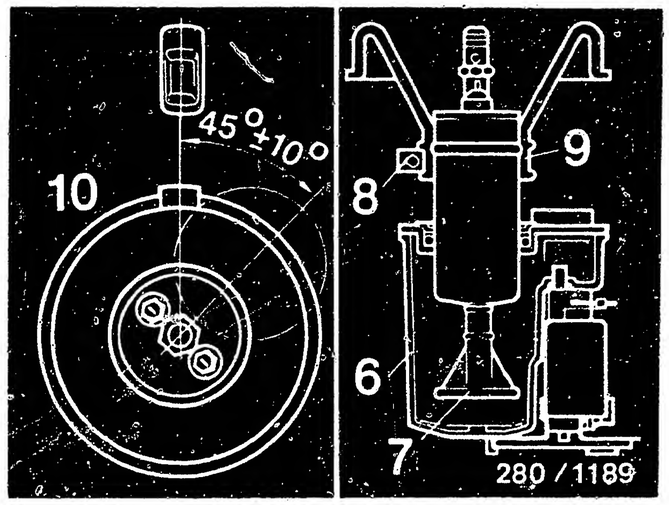
- Disconnect battery.
- Fold up rear part of the luggage-compartment floor, unscrew both fastening screws and remove the floor.
- Turn both bayonet sockets, lift up the flap and push back slightly.
- Loosen electrical connections from electric fuel pump, pre-supply pump and fuel-level sensor.
- Pinch off fuel-injection line with hose clamper.
- Unscrew inlet-union screw from the pressure connection of the electric fuel pump and pull off ring connection with fuel-injection line. Attention! Fuel may escape. Take necessary safety measures.
- Remove clamp (8) from sealing collar (9) of the electric fuel pump.
- Pull up electric fuel pump together with tank, disconnect fuel return hose from tank (5), loosen line of pre-supply pump from tank lead-through.
- Pull electric fuel pump out of tank (6) and remove strainer (7).
- Unscrew clamp (8) from sealing column (9) and pull electric fuel pump out of the collar.

Installing

- Mount sealing collar in such a way that its edge lies 50 mm above the upper edge of the fuel pump.
- Secure suction strainer (7), insert fuel pump into tank (6), position new O-ring.
- Install fuel pump in such a way that the overpressure valve of the fuel pump is offset by 45° in relation to the sealing-collar mark (10).
- Adjust overall height of the fuel pump to 250 mm.
- Proceed further in reverse sequence of steps as described under "Removing the in-tank electric fuel pump".







Trouble-shooting instructions : AUD-5010

BOSCH system : KE-Jetronic -3.3

Make of vehicle : AUDI

Basic microcard : KFZ-00..

TABLE OF CONTENTS

SPECIAL FEATURES

These trouble-shooting instructions, valid at the time of publication, apply to the following AUDI models:

AUDI 100, 100 Quattro, Gen., USA
AUDI 5000 California
Engine NF / 2.3 l / 5 cylinders 06.87->

AUDI 90, 90 Quattro, Gen.
Engine NG / 2.3 l / 5 cylinders 08.87->

* KE-Jetronic system version 3.3 with self-diagnosis and flashing-code output

* Final-controlling-element diagnosis

* Tank vent with pulsed valve

* Lambda closed-loop control

* In-tank electric fuel pump in AUDI 100

* Electronic ignition with knock control, self-diagnosis, and flashing-code output

Special information with regard to the self-diagnosis system of the KE 3.3-Jetronic:

In contrast to the version described in the basic instructions, the self-diagnosis system is equipped with a permanent memory, i.e. faults remain stored even after the ignition is switched off. The fault memory can be cleared only after the self-diagnosis and final-controlling-element diagnosis has been called up.

The following test sequence must be observed:

SPECIAL FEATURES (Continued)

Call up self-diagnosis in the input mode. If the fault memory has been cleared, take the vehicle for a test run on the road or roller-type test stand for at least 5 minutes. During this test run, accelerate engine at least once to a speed greater than 3000 min^{-1}, in the process, briefly depressing the accelerator pedal to the floor. Or, if the engine will not start, activate the starting motor for at least 6 seconds. Call up self-diagnosis with the engine not running or running at idle speed.

Activating ignition system EI-K:

Ignition ON. Bridge contact at fuel-pump relay for at least 4 seconds with fuse. Make a note of flashing code. Continue bridging contact until flashing code 0 0 0 0 (end of fault output) appears. Evaluate flashing code, see EI-K SIS.

Activating KE-Jetronic:

Possible only after "End" of EI-K fault output. Bridge contact for at least 4 seconds. Engine speed is automatically increased to approx. 1200 min^{-1}. Evaluate flashing code - see self-diagnosis test table. Continue until flashing code 0 0 0 0 ("End" of fault output) appears.

Activating final-controlling-element diagnosis:

Ignition OFF. Bridge contact. After approx. 4 seconds, ignition ON. After a further 4 seconds, disconnect the bridge. Flashing code indicates which final controlling element is energized. Continue until flashing code 0 0 0 0 ("End" of fault output) appears. Afterwards, do <u>not</u> switch off ignition, so that fault memory can be cleared.

Clearing fault memory:

Bridge contact for at least 4 seconds.
Fault memory is cleared.
Fault lamp is OFF.

STRUCTURE, USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to various causes/ component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to prevent damage to the engine, trigger boxes and control units, or to the ignition system, be sure to observe the information in the basic instructions.

ATTENTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

When testing the compression, disconnect the pump relay in order to prevent unwanted injection of fuel by the injection valves.

While the tests are in progress with the electric fuel pump running, never deflect (lift) the air-flow sensor plate, because this causes the injection valves to inject fuel. This may lead to severe damage to the engine when the engine is subsequently started.

TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.	2. Engine starts, but dies again.	3. Rough idling (engine speed, exhaust gas).	4. Poor throttle response, flat spot during acceleration.	5. Engine misfiring (ignition, injection).	6. Maximum engine power/top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
*	*	*	*	*	*	*	*			*	Self-diagnosis
*	*	*	*	*	*	*		*	*		Pressure actuator
		*									Tank-vent valve
		*									Idle actuator
*		*				*					Cold-start valve
*		*	*		*						Intake system
*	*	*	*				*				Air-flow sensor
*							*				Air-flow sensor plate
*	*			*	*						Electric fuel pump
*	*			*	*						Primary pressure
*	*	*	*	*	*	*					Differential pressure
*											Fuel system leaking
*	*	*	*	*	*		*				Injection valves
*	*	*	*		*	*					Fuel distributor

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TROUBLE-SHOOTING CHART (CONTINUED)

Customer complaint (symptoms of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.	2. Engine starts, but dies again.	3. Rough idling (engine speed, exhaust gas).	4. Poor throttle response, flat spot during acceleration.	5. Engine misfiring (ignition, injection).	6. Maximum engine power/top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
*		*			*						Throttle valve
*	*	*	*		*			*	*		Voltage supply, control unit
*	*	*	*		*	*					Temperature sensor (coolant)
		*	*								Throttle-valve switch, idle
					*			*	*		Throttle-valve switch, full load
		*	*		*						Lambda closed-loop control
*	*	*	*			*					Exhaust-gas adjustment
		*									Low-idle-speed control
*											Starting enrichment
	*										Post-starting enrichment
	*	*	*								Warm-up enrichment
			*								Acceleration enrichment
			*		*						Full-load enrichment
						*					Overrun cut-off

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SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Testing of component/function	Test instructions/ Test conditions	Terminals	Set values
1 1 1 1	Control units	Make sure whether fault-code output applies to EI-K or KE! EI-K control unit or KE control unit defective.		
2 1 2 1	Idle throttle-valve switch or lead defective	Watch out whether fault-code output applies to EI-K or KE! Idle throttle-valve switch constantly closed. Lead to terminal 28 is short-circuited to positive. Setting incorrect. Throttle valve closed: Throttle valve open: Check setting:	KE 28 EI-K 7	 0 Ω infinity Ω 0.6 mm
2 1 2 2	No engine-speed signal from ignition system	Open circuit in lead from KE control unit terminal 30 to EI-K control unit terminal 17. Check lead for continuity: Check ignition system: See SIS Overview (KFZ-00..)	KE 30 EI-K 17	 0 Ω
2 1 2 3	Full-load throttle-valve switch or lead defective	Watch out whether fault-code output applies to EI-K or KE! Full-load throttle-valve switch constantly closed. Lead to terminal 28 is short-circuited to positive. Setting incorrect. Throttle valve closed: Throttle valve open: Check setting:	KE 31 EI-K 9	 infinity Ω 0 Ω 68...76°
2 1 4 1	Knock control at control stop	Test ignition system: See SIS Overview (KFZ-00..)		
2 1 4 2	Knock sensor or lead defective	Test ignition system: See SIS Overview (KFZ-00..)		

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Fault indication Flashing code	Checking of component/function	Test instructions/ Test conditions	Terminals	Set values
2 2 2 3	Altitude sensor or cable faulty	Watch whether fault-code output concerns EI-K or KE! Check voltage supply to altitude sensor at terminals 2 and 3. Check voltage signal at terminals 1 and 3. Open circuit. Check cable for continuity:	KE 25, 26,35 EI-K 2	 4.35...5.35 V see test specifications 0 Ω
2 2 3 2	Potentiometer at air-flow sensor or cable faulty	Check voltage supply to potentiometer at terminals 1 and 3. Check voltage signal at terminals 2 and 3. Open circuit. Check cable for continuity:	KE 23, 26,35	 4.35...5.35 V Voltage rise, max. 5.35 V 0 Ω
2 2 3 3	Reference voltage for load and altitude signal for EI-K control unit	Cable from KE control unit teminal 26 to EI-K control unit terminal 21 interrupted. Check cable for continuity:	KE 26 EI-K 21	 0 Ω
2 3 1 2	Temperature sensor (engine) or cable faulty (double NTC, one connection for KE-Jetronic)	Watch whether fault-code output concerns EI-K or KE! Cable from KE control unit terminal 3 to temperature sensor (engine) interrupted or short circuit to ground. Check cable for continuity: Check cables for short circuit to ground: Resistance value, temperature sensor (engine) * Engine cold (+15°C...+30°C) * Engine at operating temperature (approx. +80°C)	KE 3	 0 Ω infinity Ω 1300...3600 Ω 250... 390 Ω

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Fault indication Flashing code	Checking of component/function	Test instructions/ Test conditions	Terminals	Set values
2 3 4 1	Lambda closed-loop control outside working range (above or below control limits)	Fault occurs only at idle/in part-load range. Fault detected 6 minutes after starting at the earliest. Possible causes of fault: * Lambda closed-loop control not working or functioning incorrectly, sensor lead short-circuted, lambda-sensor heating faulty. * Start valve leaking. * Intake system leaking (unmetered air). * Tank-vent. valve permanently open. * Incorrect idle setting.	— —	— —
2 3 4 2	Lambda sensor or cable faulty	Cable from KE control unit terminal 7 to lambda sensor broken, short-circuited to ground or battery voltage Check cable for continuity: Check cables for short circuit to ground and battery voltage: Pay attention to chafing points! Sensor heating faulty. Resistance value, sensor clogged:	KE 7	0 Ω infinity Ω 1...15 Ω
4 3 4 1	Pressure actuator or cable faulty	Check resistance of pressure actuator: Check cable for continuity:	KE 4,5	16...22 Ω 0 Ω
4 3 4 3	Tank-ventilation valve or cable faulty	Cable from KE control unit terminal 15 to tank-ventilation valve broken or short circuit to ground. Check voltage supply (ignition terminal 15) to tank-ventilation valve: Check cable for continuity: Check cables for short circuit to ground:	KE 15	Battery voltage 0 Ω infinity Ω

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

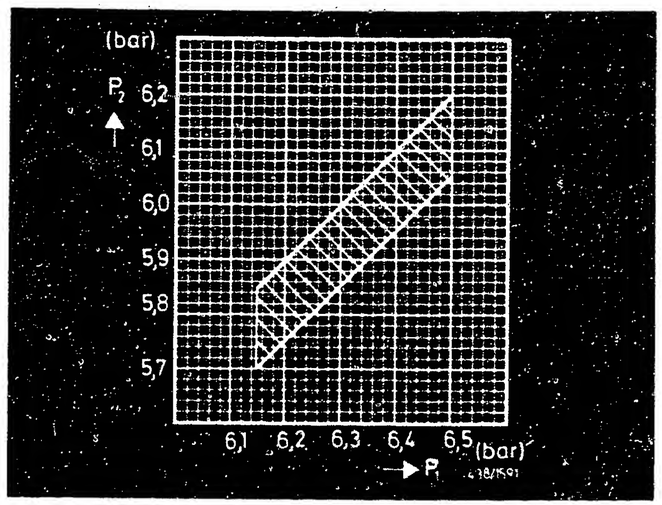
Fault indication Flashing code	Checking of component/function	Test instructions/ Test conditions	Terminals	Set values
4 4 3 1	Idle actuator or cable faulty	Cable from KE control unit terminal 17 to idle actuator broken or short circuit to ground. Voltage supply (ignition terminal 15) to idle actuator interrupted. Check cable for continuity: Check cables for short-circuit to ground:	KE 17	 Battery voltage 0 Ω infinity Ω
4 4 4 3	Start valve or cable faulty	Cable from KE control unit terminal 16 to cold-start valve broken or short circuit to ground. Voltage supply (ignition terminal 15) to start valve broken. Check cables for continuity: Check cables for short circuit to ground:	KE 16	 Battery voltage 0 Ω infinity Ω
4 4 4 4	No fault			
0 0 0 0	End of fault output			

TEST SPECIFICATIONS

No.	Testing/Test conditions	Set value
1	Engine-speed signal from EI-K control unit to KE control unit:	approx. 5,0 V
2	Supply voltage for altitude sensor: Voltage signal from altitude sensor: Sea level 500 m 1000 m 1500 m 2000 m 3000 m	4,35...5,35 V 3,2...4,7 V 2,8...4,0 V 2,4...3,5 V 2,0...3,0 V 1,5...2,5 V 0,8...1,6 V
3	Supply voltage for potentiometer on air-flow sensor: Voltage signal from potentiometer: air-flow sensor plate in neutral position air-flow sensor plate deflected	4,35...5,35 V 5,35 V max. 21 V
4	Resistance value, temperature sensor (coolant): engine cold (+15°C...+30°C) Engine at normal operating temperature (approx. 80°C)	 1300...3600 Ω 250... 390 Ω
5	Lambda closed-loop control: open-loop control operation closed-loop control operation rich stop lean stop	 -1...+1 mA (static) -1...+1 mA (pulsating) max. + 10 mA max. - 10 mA
6	Resistance value, pressure actuator:	16...22 Ω
7	Resistance value, tank-vent valve:	35...55 Ω
8	Resistance value, idle actuator:	4...12 Ω
9	Resistance value, cold-start valve:	6...14 Ω

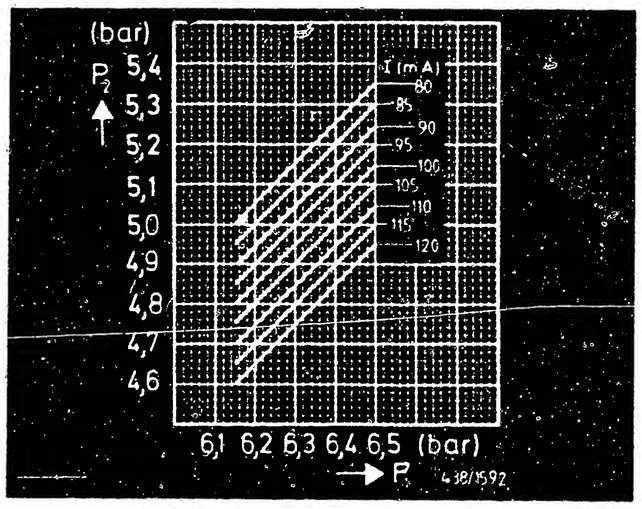
TEST SPECIFICATIONS (CONTINUED)

No.	Test/test condition	Set value	
10	Position of air-flow sensor plate (zero position) beneath basic position:	1,9...3,0 mm	
11	Air-flow sensor plate idle motion:	0,1...2,0 mm	
12	Electric fuel pump – fuel delivery: Supply voltage (under load):	min. 1160 cm ^{3} /min min. 11,5 V	
13	Fuel distributor – primary pressure:	6,15...6,5 bar	
14	Differential pressure Take lower-chamber pressure "warm" set value in accordance with measured primary pressure from upper diagram (actuator current = 0 mA) Take lower-chamber pressure "cold" set value in accordance with measured primary pressure and actuator current from lower diagram. Simulation of "cold" state: switch on ignition (closed-circuit current approx. 100 mA)		
15	Leakage test for entire system: Minimum pressure after 10 min.: Minimum pressure after 20 min.:	 3,3 bar 3,2 bar	
16	Opening pressure of injection valves:	3,7...4,8 bar	
17	Comparative fuel-delivery measurement: Actuator current: 0A	Setting: (cm ^{3} /min)	Max. perm. quantity: (cm ^{3} /min)
	Idle: Part load: Full load:	6,0 40,0 100,0	6,6 42,5 109,0
	Minimum quantity at max. deflection of air-flow sensor plate:	125,0 cm ^{3} /min	



P_1 = Primary pressure
P_2 = Lower-chamber press.
I = Actuator current

p_1 = Primary pressure
p_2 = Lower-chamber pressure
I = Actuator



TEST SPECIFICATIONS (CONTINUED)

No.	Testing/Test condition	Set value
18	Rate of flow, KE restriction	130...150 cm ^{3} /min
19	Control-unit functions:	
	Starting enrichment (corresp. to 20°C)	30...50 mA
	Post-start enrichment (corresp. to 20°C)	20...30 mA
	Warm-up enrichment 1) (corresp. to 20°C)	10...20 mA
	Acceleration enrichment * Slowly increase speed	Current value rises
	Full-load enrichment (corresp. to engine at normal operating temperature)	4...10 mA
	Overrun cut-off (corresp. to engine at normal operating temperature)	-40...-60 mA
20	CO-content adjustment 2)	
	Idle speed:	670...770 min $^{-1}$
	CO-content: * Lambda sensor disconnected Test value Setting	 0,3...3,0 % by vol. 0,6...1,0 % by vol.
	* Lambda sensor connected Pressure-actuator current	0,3...2,2 % by vol. -1...+1 mA

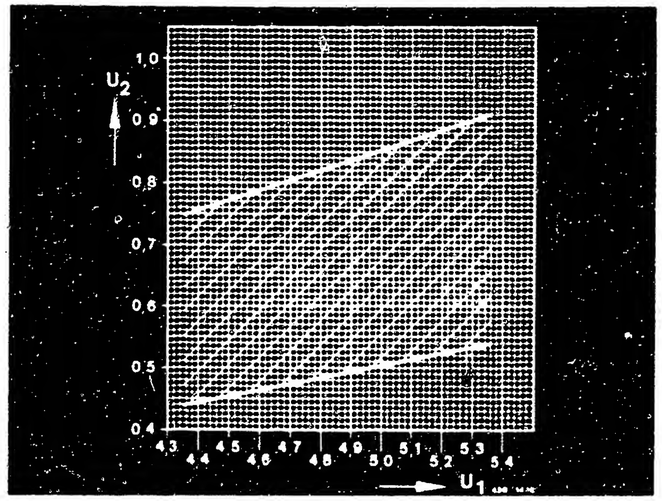
1) Keep measuring time short in order to prevent over-enrichment and thus damage to the catalytic converter.

2) Notes on CO-content adjustment:

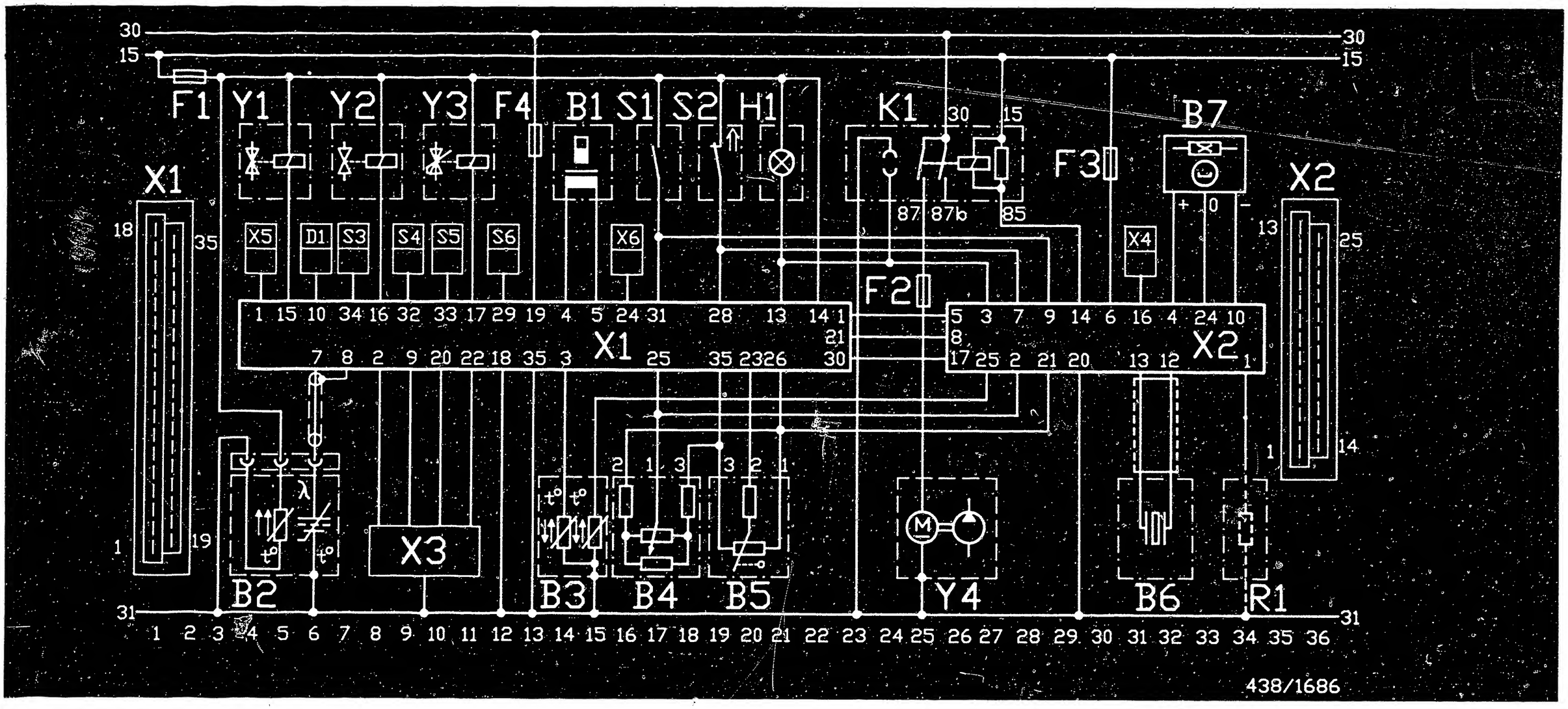
The idle speed cannot be adjusted.
Engine-oil temperature at least 80 °C.
The crankshaft-breather hose must be disconnected and sealed off tightly.
Disconnect hose line to the activated-carbon filter from the air scoop (bracket remains open in the scoop).

TEST SPECIFICATIONS (CONTINUED)

No.	Testing/Test conditions	Set value
21	Signal, air-flow sensor potentiometer (measurement necessary only when idling and part-load behavior are poor). * Measure supply voltage at potentiometer terminals 1(+) and 3(-) and not down: * Measure voltage signal of potentiometer terminals 2(+) and 3(-) with engine at normal operating temperature and at idle speed and compare with set value from chart opposite.	 4,35...5,35 V see chart



U_1 = Supply voltage, potentiometer
U_2 = Potentiometer voltage signal



B1 = Pressure actuator
B2 = Lambda sensor
B3 = Temperature sensor (engine)
B4 = Altitude sensor
B5 = Air-flow-sensor potentiometer
B6 = Knock sensor
B7 = Hall generator
D1 = Connection, on-board computer
F1 = Fuse 28 (15 A)
F2 = Fuse 13 (15 A)
F3 = Fuse 24 (10 A)
F4 = Fuse 19 (10 A)
H1 = Diagnostic lamp
K1 = Electric-fuel-pump relay with contacts for triggering diagnosis
R1 = Resistor, variant encoding
S1 = Throttle-valve switch (full load)
S2 = Throttle-valve switch (idle)
S3 = Connection, transmission switch (In vehicles with man.-shifted transm. to ground)
S4 = Connection, air conditioner (readiness)
S5 = Connection, air conditoner (compressor)
S6 = Connection, overrun-cutoff suppr.
X1 = Plug, KE control unit
X2 = Plug, EI-K control unit
X3 = Plug, parameter encoding
X4 = Plug, ignition trigger box
X5 = Connection, diagnostic interface
X6 = Connection, idle encoding
Y1 = Tank-ventilation valve
Y2 = Cold-start valve
Y3 = Idle actuator
Y4 = Electric fuel pump

ELECTRICAL TERMINAL DIAGRAM

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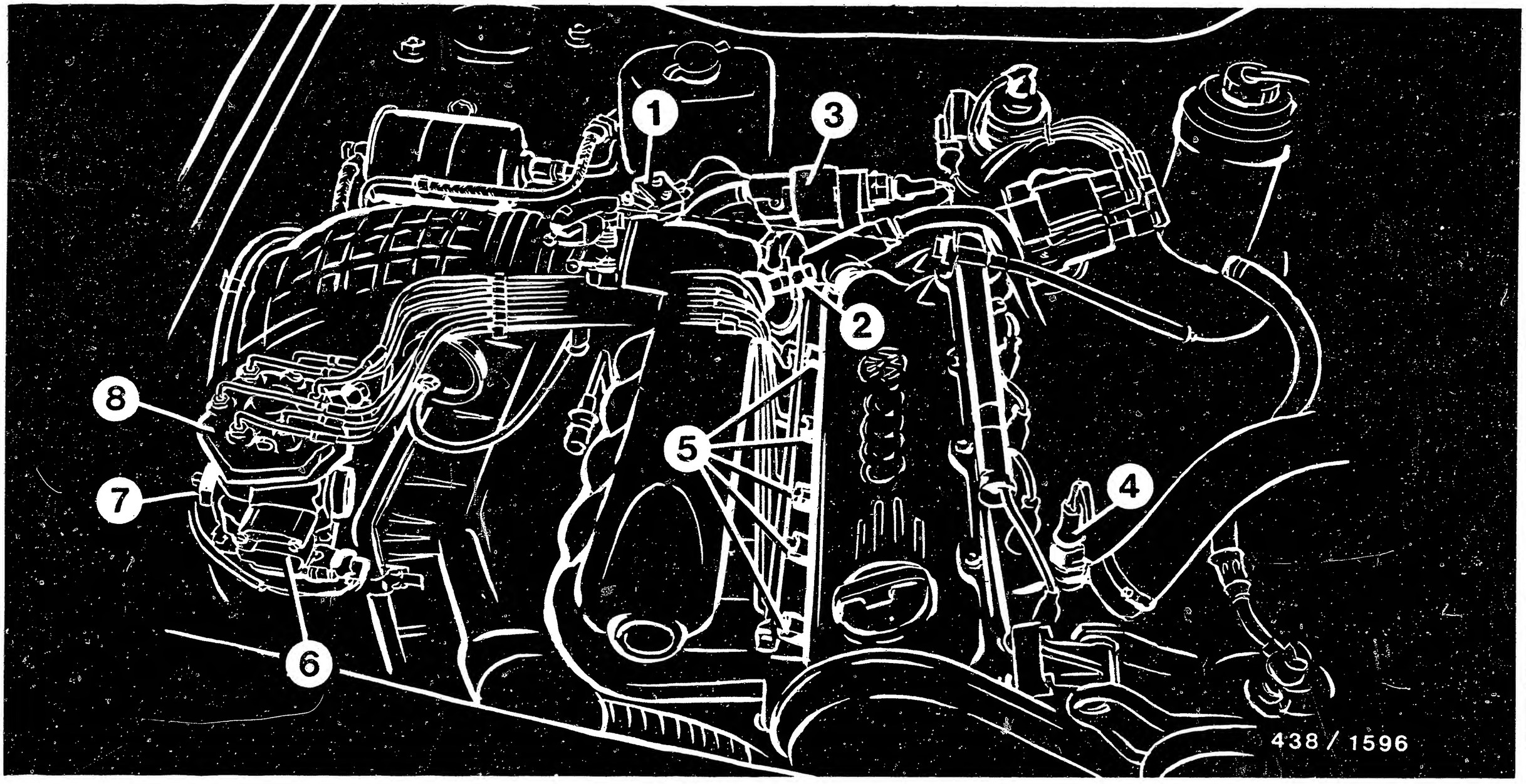


INSTALLATION POSITION OF COMPONENTS (in picture: AUDI 100)

1 = Throttle-valve switch (full load).
The throttle-valve switch, idle (not visible in picture) is located on the underside of the throttle-valve assembly.
2 = Start valve
3 = Idle actuator
4 = Temperature sensor (engine)
5 = Injection valves
6 = Pressure actuator
7 = Potentiometer at air-flow sensor
8 = Fuel distributor
9 = Fuel filter

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

AUDI 100:

* EI-K control unit:
  In driver's footwell.

* Altitude sensor:
  Above the EI-K control unit.
  The components are accessible when the shelf, the unlocking mechanism for the engine-compartment hood and the side covering are removed.

* KE control unit:
  In passenger's footwell. The control unit is accessible when the shelf and side covering are removed.

* Fuel accumulator:
  On vehicle underbody between rear axle and fuel tank.

* Pressure regulator:
  Next to mixture-control unit in right-hand wheel arch.

* Activated-carbon filter with tank-ventilation valve:
  Next to mixture-control unit in right-hand wheel arch.

* In-tank electric fuel pump:
  Accessible from the luggage compartment.
  For removal, take away luggage-compartment mat and unscrew round closing cover (3 screws).

* Catalytic converter and lambda sensor:
  In exhaust system, in the region behind the front axle.

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

AUDI 90:

* EI-K control unit:
  To the side in passenger's footwell, accessible when side panelling is removed.

* Altitude sensor:
  Above EI-K control unit.

* KE control unit:
  Behind the glove box, accessible when the lower panelling is removed.
  (2 screws).

* Injection valves:
  Fitted as in AUDI 100, but access is difficult due to different configuration of intake manifold.
  To improve accessiblity, disconnect intake manifold at individual tubes.

* Components of fuel-supply system:
  Electric fuel pump, fuel accumulator and fuel filter are on vehicle underside, in the region in front of the rear axle.

* Catalytic converter and lambda sensor:
  In exhaust system in the region behind the front axle.

* Activated-carbon filter:
  On left-hand wheel arch; the tank-ventilation valve on the airscoop of the air-flow sensor.

T A B L E O F C O N T E N T S

Trouble-shooting instructions	: BMW-518
BOSCH System	: Computer-aided transmission shift
Vehicle make	: BMW
Basic microcard	: KFZ-00..

Special features

This microcard contains the testing instructions for the electronic transmission control in BMW models 535i, 635CSi, 735i as of 10.84, 325i and 525e as of 9.1985.
The transmission control has an independent control unit, but is linked to the Motronic through various inputs and outputs.
For testing with the universal test adapter, it is necessary to use the special adapter lead 1 684 463 161 (GS1).
If no fault is found in the transmission control, continue trouble-shooting with the Motronic (KFZ-00..).

1. Rapid diagnosis chart for universal test adapter

The following rapid diagnosis chart makes it possible for the expert to quickly check the electrical part of the system with the univeral test adapter. Even if a fault occurs, still go through all test steps one after the other.

The rapid diagnosis chart contains the following information:

* Switch positions on universal test adapter
* Sequence of test steps
* Notes on how to operate the universal test adapter or other components.
* Readings on multimeter and motortester
* The Trouble-shooting column in some cases refers to defective components which are tested in later test steps.

If detailed instructions and information are necessary, use similar microcard SIS-BMW-00/E121.

Rapid diagnosis chart for universal test adapter with adapter lead 1 684 463 161

Test step	Switch position V	Switch position Ω	Remarks	Test specifications (reading)	Cause of trouble
1	V	1	Selector switch in position "P". Ignition off. Disconnect transmission control unit and pump relay. Measure insulation resistance of RPM sensor shielding. Term. 23 to term. 5 (ground).	> 100 k Ω	* RPM sensor * Lead (or shielding)
2	V	2	Measure insulation resistance of RPM sensor. Term. 8 to term. 5.	> 100 k Ω	
3	V	3	Measure insulation resistance between shielding and RPM sensor lead. Term. 23 to term. 27.	> 100 k Ω	
4	V	4	Measure winding resistance of RPM sensor. Term. 8 to term. 27	0.7 ... 1.8 k Ω	
5	V	5	Measure shunt resistance of kick-down switch. Do not press accelerator Term. 2 to term. 5.	> 100 k Ω	* Kick-down switch
6	V	6	Measure insulation resistance of solenoid-operated valves and of pressure regulator in transmission. Term. 1 to term.5.	> 100 k Ω	* Leads * Solenoid-op. valves (in transmission) * Pressure regulator (in transmission)
7	V	7	Not applicable		
8	V	8	Program switch of vehicle in position "S". Measure insulation resistance of program switch. Term. 14 to term. 5.	> 100 k Ω	* Program switch
9	V	9	Check connection between term. 10 and term. 6.	635 CSi: < 10 Ω 535i + 735i: infinity Ω	* Establish/take apart corresponding connection.
10	V	10	Check connection between term. 26 and term. 6.	535i: < 10 Ω 635CSi + 735i: infinity Ω	

Rapid diagnosis chart for universal test adapter (continued)

Test step	Switch position V	Switch position Ω	Remarks	Test specifications (reading)	Cause of trouble
11/12	| V	11/12	Not applicable		
13	| V	13	Check warning lamp for electronic transmission control. Measure resistance between term. 33 and term. 5.	10 ... 150 Ω	* Warning lamp for transmission control * Gear indicator plug connector
14	| V	14	Press accelerator as far as it will go. Measure resistance of kick-down switch. Term. 2 to term. 5.	< 10 Ω	* Kick-down switch * Plug connector
15	| V	15	Measure resistance of ground leads between term. 19 and term. 5	< 10 Ω	* Ground leads * Contact resistances
16	| V	16	Measure winding resistance of solenoid-operatated valve MV1 (in transmission). Term. 16 to term. 1.	25 ... 65 Ω	* Transmission plug connector * Solenoid-op. valve 1
17	| V	17	Measure winding resistance of solenoid-operated valve MV2 (in transmission). Term. 17 to term. 1.	25 ... 65 Ω	* Transmission plug connector * Solenoid-op. valve 2
18	| V	18	Measure winding resistance of solenoid-operated valve for reverse-gear lock (in transmission). Term. 20 to term. 21.	25 ... 65 Ω	* Transmission plug connector * Reverse-gear lock solenoid-op. valve
19	| V	19	Measure winding resistance of solenoid-operated valve for converter clutch (in transmission). Term. 25 to term. 1.	25 ... 65 Ω	* Transmission plug connector * Converter clutch solenoid-op. valve
20	| V	20	Measure winding resistance of pressure regulator (in transmission). Term. 22 to term. 1	4.5 ... 9 Ω	* Transmission plug connector * Pressure regulator
21	| V	21	Not applicable		

Rapid diagnosis chart for universal test adapter (continued)

Test step	Switch position V	Switch position Ω	Remarks	Test specifications (reading)	Cause of trouble
22	3	22	Voltage measurement. Ω switch position "22"; V switch position " 3". Selector switch in position "P". Pull on handbrake. Measure supply voltage for transmission control. Term. 35 to term. 5.	10 ... 15 V	* Main relay (term. 87) * Plug connector to Motronic (13-pin) * Corresponding leads
23	4	22	Selector switch in position 1. Measure voltage. Term. 18 to term. 5.	> 6 V	* Selector switch * Corresponding plug connectors and leads
24	4	22	Selector switch in position 2. Measure voltage.. Term. 18 to term. 5.	< 1 V	
25	5	22	Selector switch in position 2. Measure voltage. Term. 28 to term. 5.	> 6 V	
26	5	22	Selector switch in position 3. Measure voltage. Term. 28 to term. 5.	< 1 V	
27	6	22	Selector switch in position 3. Measure voltage. Term. 29 to term. 5.	> 6 V	
28	6	22	Selector switch in position D. Measure voltage. Term. 29 to term. 5.	< 1 V	
29	7	22	Selector switch in position D. Measure voltage. Term. 30 to term. 5.	> 6 V	
30	7	22	Selector switch in position N. Measure voltage. Term. 30 to term. 5.	< 1 V	
31	8	22	Selector switch in position N. Measure voltage. Term. 4 to term. 5.	> 6 V	
32	8	22	Selector switch in position R. Measure voltage. Term. 4 to term. 5.	< 1 V	

Rapid diagnosis chart for universal test adapter (continued)

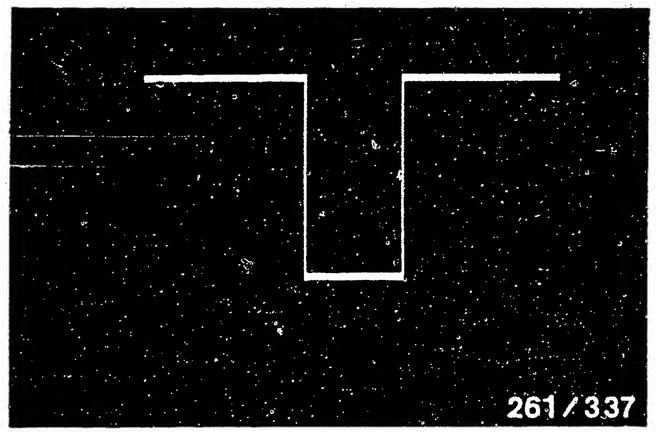
Test step	Switch position V	Switch position Ω	Remarks	Test specifications (reading)	Cause of trouble
33	8	22	Selector switch in position P. Measure voltage. Term. 4 to term. 5.	< 1 V	* Selector switch
34	9	22	Switch off ignition. Connect sockets 1 and 2 with a lead or with ammeter (1.5A). Selector switch in position P. Connect control unit. Switch on ignition. Set program switch to position E. Measure voltage (term. 15 to term. 5). Follow sequence of operations!	> 4 V	* Program switch
35	9	22	As test step 34, but program switch position 3-2-1	< 0,8 V	
36	10	22	As test step 35, but measure term. 14 to term. 5.	< 1 V	
37	10	22	As test step 36, but program switch position E	< 0,5 V	
38	11	22	Briefly operate starting motor; then do not switch off ignition and do not press accelerator. Measure term. 31 to term. 5. Pump relay disconnected.	> 2 V	* Plug connector to Motronic (13-pin) * Throttle-valve sensor * Control unit
			As above, but with wide-open throttle.	< 1 V	
39/40	12/13	22	Not applicable		
41	14	22	Check power supply to throttle-valve sensor. Measure term. 9 to term. 5.	> 4 V	* Control unit
42	15	22	Measure voltage at tap of throttle-valve sensor - term. 7 to term. 5 - with accelerator in rest position.	< 1 V	* Throttle-valve sensor and adjustment * Plug connector to Motronic (13-pin)
			As above, but with wide-open throttle.	> 4 V	
43.1	16	22	Connect pump relay. Let engine run and set program switch to "S". Warning lamp for transmission control comes on until self-test has been successfully completed.	After self-test, warning lamp for transmission control goes out	* ti-/TD signal absent * Torque-reduction lead, term. 24 Motronic control unit term. 10 * Control unit * Solenoid-operated valves

Rapid diagnosis chart for universal test adapter (continued)

Test step	Switch position V	Switch position Ω	Remarks	Test specifications (reading)	Cause of trouble
43.2	16	22	Selector switch in position "N". Engine idling. Measure voltage. Term. 20 to term. 5.	10...15 V	* Control unit (reverse-gear lock output)
44	17	22	As test step 43.2 but term. 16 to term. 5.	< 1 V	* Control unit (solenoid-op. valve 1 output)
45	18	22	As test step 43.2 but term. 17 to term. 5.	< 1 V	* Control unit (solenoid-op. valve 2 output)
46	19	22	As test step 43.2 but term. 25 to term. 5.	10...15 V	* Control unit (converter clutch output)
47	16	22	Drive vehicle onto chassis dynamometer. Program switch in position "S", selector switch at "D". Slowly bring speed to approx. 20 km/h Term. 20 to term. 5.	< 1 V at approx. 20 km/h	* Control unit (reverse-gear lock output) * No RPM sensor signal (test steps 58, 59)
48	17	22	As test step 47, but vehicle speed approx. 50 km/h. Term. 16 to term. 5.	10...15 V at approx. 50 km/h	* Control unit (solenoid-op. valve 1 output) * No RPM sensor signal
49	18	22	As test step 47, but vehicle speed approx. 90 km/h. Term. 17 to term. 5.	10...15 V at approx. 90 km/h	* Control unit (solenoid-op. valve 2 output) * No RPM sensor signal

Rapid diagnosis chart for universal test adapter (continued)

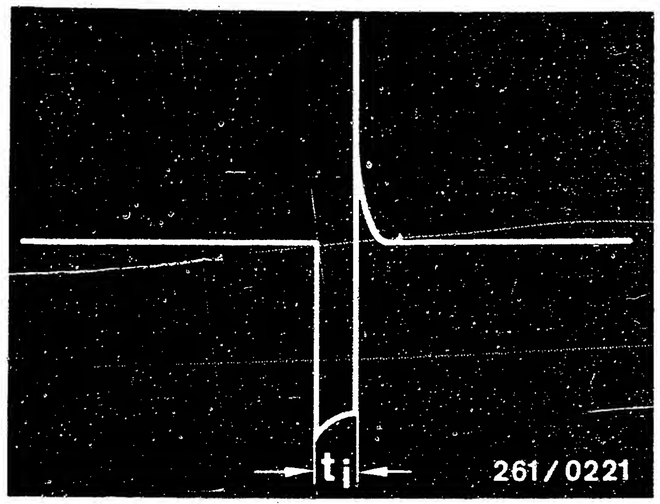
Test step	Switch position V	Switch position Ω	Remarks	Test specifications (reading)	Cause of trouble
50	19	22	After test step 49, foot off accelerator, switch ignition off briefly and then on again. Slowly raise speed to approx. 110 km/h. Otherwise as test step 47. Term. 25 to term. 5.	< 1 V at approx. 110 km/h	* Control unit (converter clutch output) * No RPM sensor signal
51	20	22	Not applicable		
52	20	22	Vehicle on chassis dynamometer. Engine idling. Selector switch at "D". Measure current at sockets 1 and 2 on universal test adapter (current measurement in lead 22). Warning: Do not cause a short circuit to ground!	900... 1000mA	* Control unit (pressure regulator output)
53	20	22	As test step 52, but briefly accelerate engine	Reading decreases	
54	21	22	Vehicle on chassis dynamometer. Program switch in position "1-2-3". Selector switch at "1". Raise engine speed to above 1500 min^{-1}. Shift selector switch to position "2" etc. Observe signal term. 24 to term. 5 on oscilloscope.	Approx. 1 sec. after gear shift 1 to 2 negative pulses (see top picture)	* Connection between transmission control unit term. 24 and Motronic control unit term. 10 through 13-pin plug * Transmission control unit (torque-reduction output) * Motronic control unit (input of map switch term. 10)

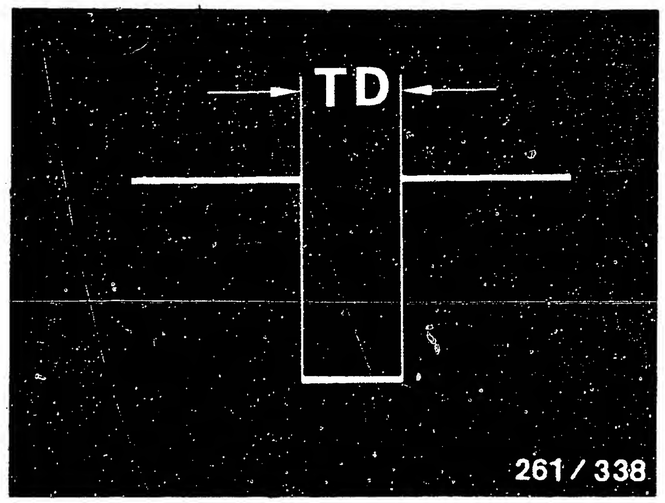


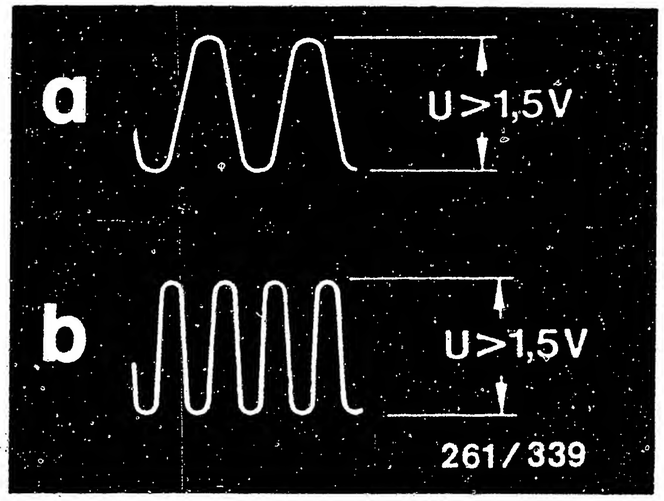
Torque-reduction signal

Rapid diagnosis chart for universal test adapter (continued)

Test step	Switch position V	Switch position Ω	Remarks	Test specifications (reading)	Cause of trouble
55	21	22	Not applicable		
56	22	22	Vehicle on chassis dynamometer. Program switch in position "S". Selector switch in position "D". Engine idling. Connect oscilloscope to test wells. Measure t_i signal. Term. 11 to term. 5.	See top picture for signal.	* Plug connector to Motronic (13-pin) * Motronic control unit
57	23	22	As test step 56, but measure TD signal. Term. 21 to term. 5.	See center picture for signal.	
58	2	22	As test step 56, but vehicle speed approx. 10 km/h. Measure RPM sensor signal. Term. 8 to term. 5.	See bottom picture (a) for signal	* Transmission plug connector * RPM sensor in transmission (incorrectly adjusted)
59	2	22	As test step 58, but vehicle speed approx. 20 km/h. Signal frequency and voltage amplitude increase.	See bottom picture (b) for signal	





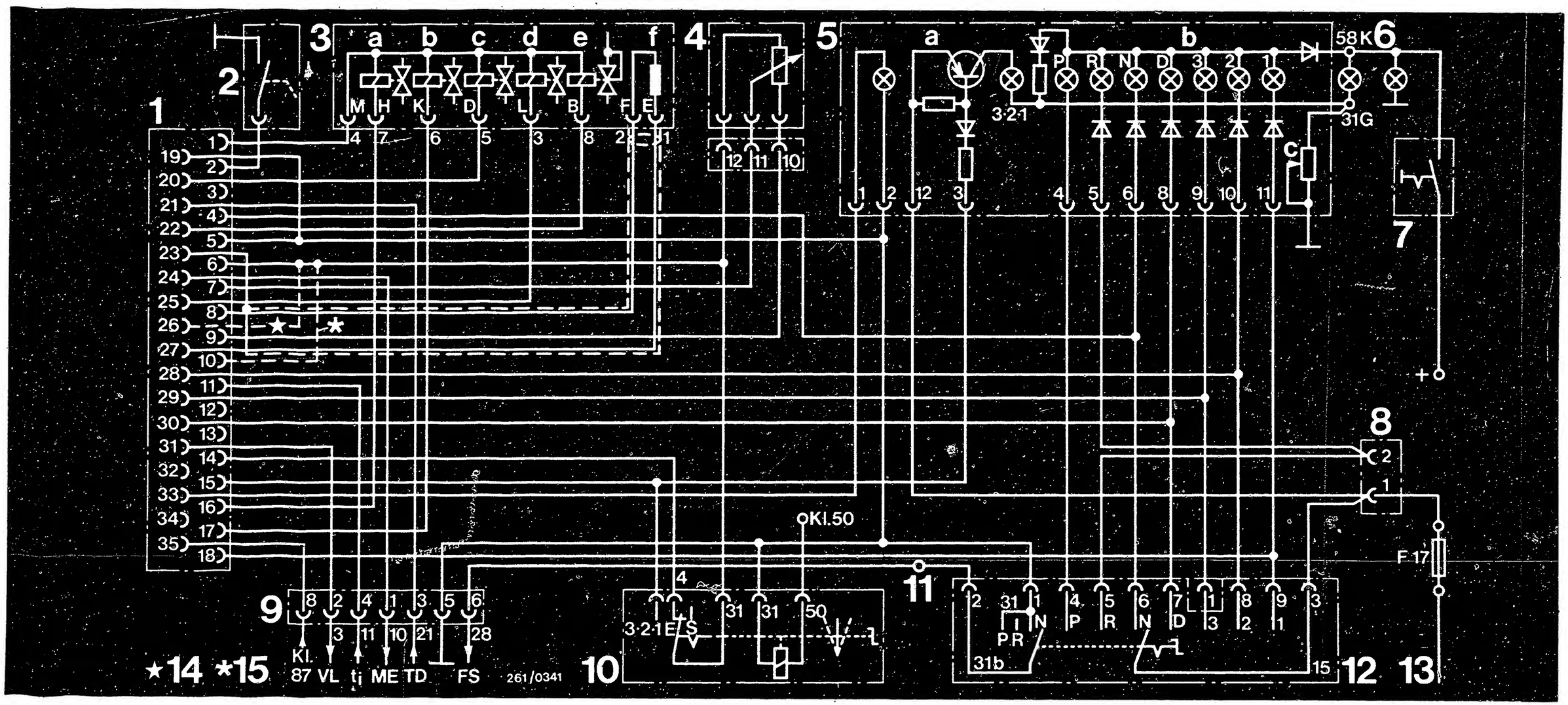


2. Test specifications

The stated test specifications apply to measurements directly on the component or on the 35-pin plug without test adapter connected.

RPM sensor (in transmission):	0.7 ... 1.8 k Ω
Press. regulator (in transmission):	1.7 ... 4.5 Ω
Solenoid-op. valves (in transmission) MV1 and MV2, reverse-gear lock and converter clutch, each:	22 ... 60 Ω
Kick-down switch actuated:	0 Ω
Selector switch in position 1, 2, 3, D, N, R, P: U_B with ignition on.	
Program switch in position E and 3-2-1: 0 Ω to ground, each.	
Throttle-valve potentiometer:	
Total resistance between pin 1 and socket 3 (between pins 1 and 2 in case of 6-pin plug):	3... 5 k Ω
Resistance between wiper socket 2 and socket 3 (between pins 2 and 3 in case of 6-pin plug): (Potentiometer removed and at stop).	250...800 Ω

For production reasons: continued on the following coordinate.

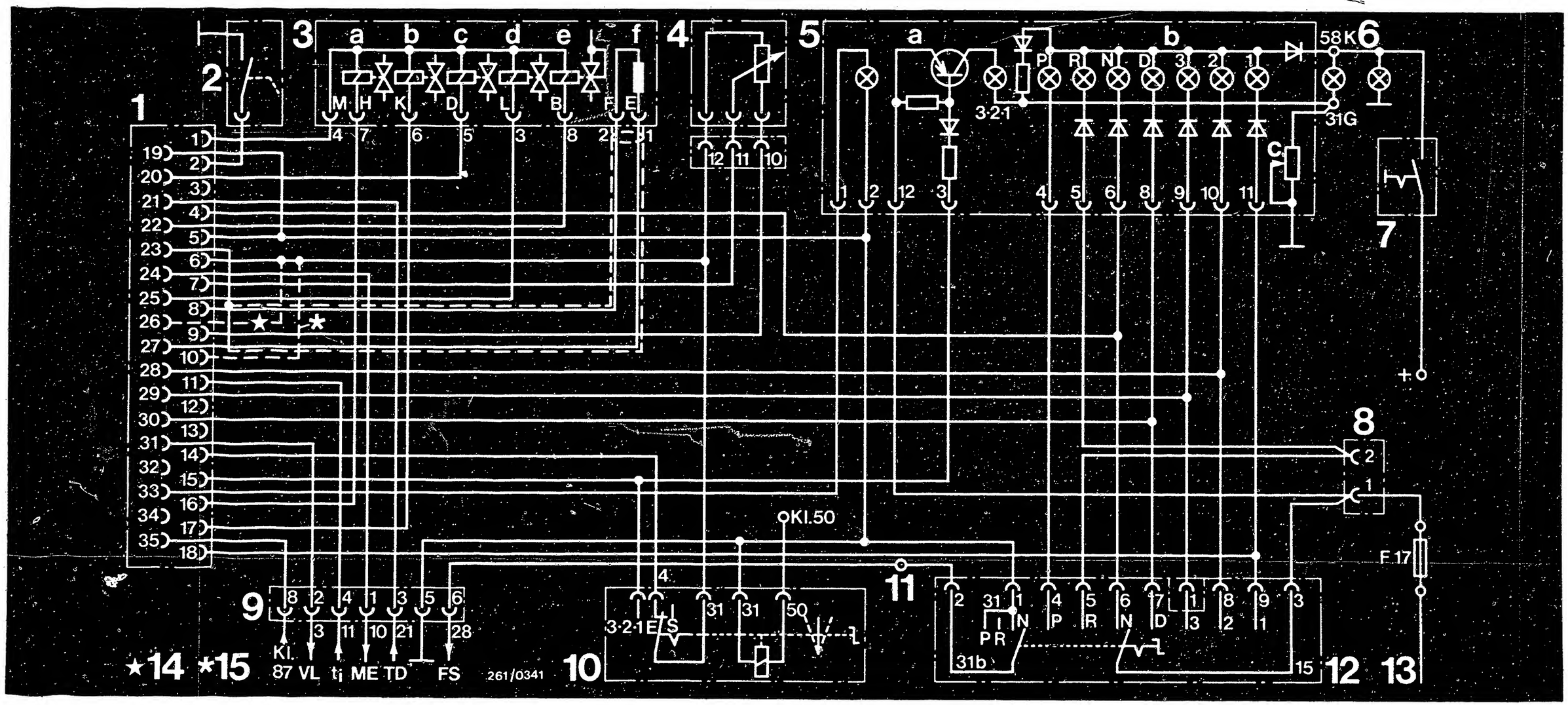


1 = Transmission control, wiring-harness plug, control-unit end
2 = Kick-down switch
3 = Transmission with plug connector (8-pin)
3a = Solenoid-op. valve 1
3b = Solenoid-op. valve 2
3c = Reverse-gear lock solenoid-op. valve
3d = Converter clutch solenoid-op. valve
3e = Pressure regulator
3f = Output RPM sensor
4 = Throttle-valve sensor
5 = Indicator unit
5a = Warning lamp for electronic transmission control
5b = Gear indicator

3. Electrical terminal diagram

H19 ⟹

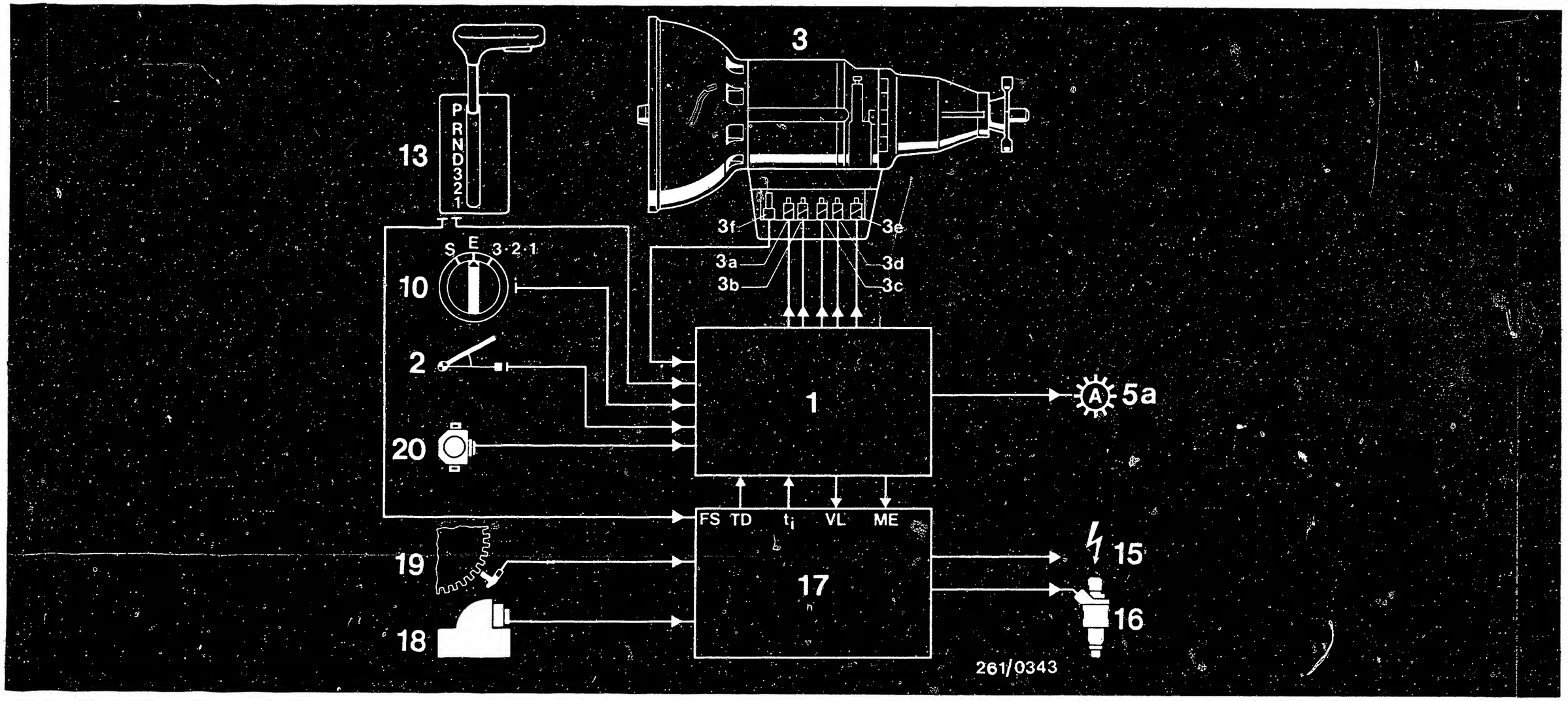
H20 ⟺



5c = Brightness control
6 = Instrument and vehicle illumination
7 = Light switch (side-marker lights)
8 = Plug connector on center console to backup lamp
9 = Plug connector (13-pin) to Motronic wiring harness (term. 87 on main relay)
10 = Program switch
11 = To starting-disable relay term. 85
12 = Selector switch
13 = To ignition/starting switch term. 15
14 = 535i only
15 = 635 CSi only

t_i = Load signal
TD = RPM information
VL = Full-load output
ME = Torque control (Ignition-timing control)
FS = Driving-position information

Electrical terminal diagram (continued)



1 = Control unit for electronic transmission control
2 = Kick-down switch
3 = Transmission
3a, 3b = Gearshift solenoid-op. valves
3c = Rev.-gear lock solenoid-op. valve
3d = Converter clutch solenoid-op. valve
3e = Pressure regulator
3f = Output RPM sensor
5a = Warning lamp for electronic transmission control

10 = Program switch
13 = Selector switch
15 = Ignition
16 = Gasoline injection
17 = Motronic control unit
18 = Air-flow sensor
19 = Engine-speed sensor
20 = Throttle-valve sensor

TD = Engine-speed information
t_i = Load signal
VL = Full-load output
ME = Torque control (ignition-timing control)
FS = Driving-position information

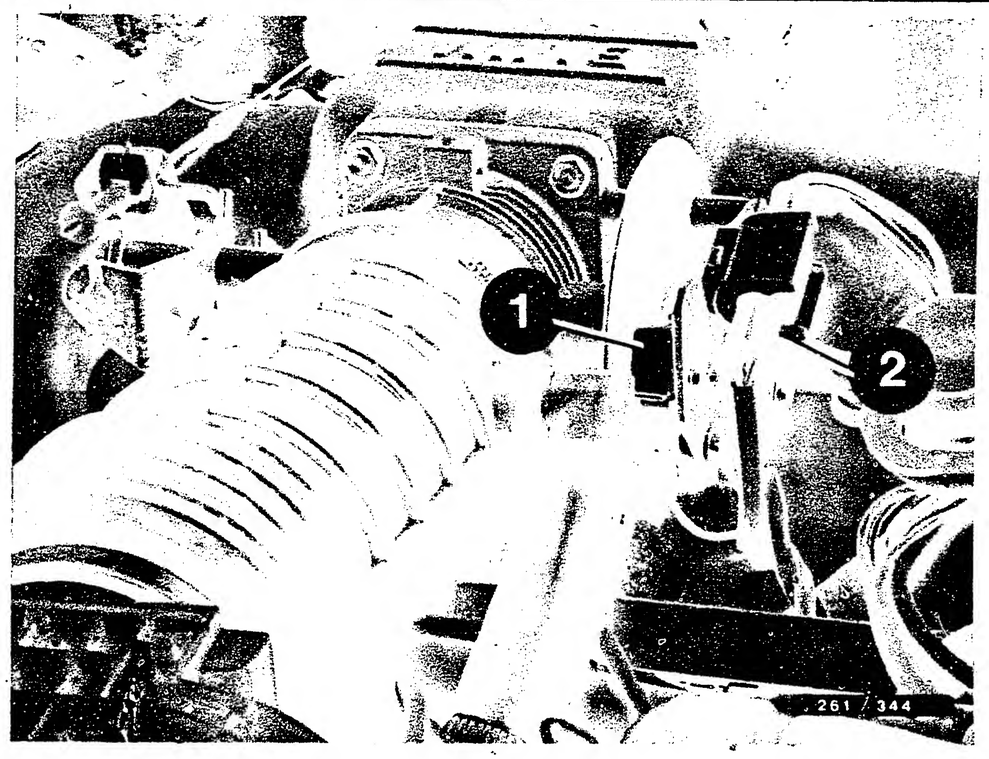
4. Basic circuit diagram

5. Installation position of components

Control unit for electronic transmission control:		in glove compartment behind loudspeaker cover; A-pillar, left
RPM sensor Sol.-op. valves Press. regulator	>	in transmission
Main relay for transmission control and Motronic:		
5 and 6 series	:	in glove compartment
7 series	:	on firewall
Selector switch	:	on driver's console
Program switch	:	on driver's console
Indicator unit Warning lamp for electronic transmission control	>	in dashboard
Kick-down switch:		under accelerator
Throttle-valve potentiometer 1)	:	on throttle-valve assembly

1) = If throttle-valve sensor with 6-pin connector, pot and a microswitch (idle contact) are accommodated in a housing.

Note:
Adjustment is via idle contact, then check voltage at plug between term. 3 and term. 2 - switch on ignition:
Accelerator in rest position : < 1 V
Accelerator in full-load position: > 4 V



1 = Microswitch (idle)
2 = Potentiometer

The throttle-valve potentiometer (3-pin connection) is mounted on a mounting plate on the throttle-valve assembly and is covered by a rubber cover.
Adjust throttle-valve potentiometer as follows:
Connect universal test adapter and control unit.

Ω switch in position 22,
V switch in position 15.

Switch on ignition.

Slightly loosen fastening screws. Turn potentiometer until wiper voltage is 0.9 V.
Make sure that the throttle valve remains at idle stop while testing. Tighten fastening screws. Check wiper voltage at full load: 4...5.5V (is not adjustable).

6. Test equipment and tools

Description	Designation	Part number
Universal test adapter	ETT 018.01	0 684 101 801
Adapter lead	GS 1	1 684 463 161
Motortester	e.g. MOT 201 or MOT 300 and MOT 400	0 684 000 201 0 684 000 300 0 684 000 400
Multimeter (Internal resistance min. 20 k Ω /V)		Commercially available e.g. Metrawatt GmbH Type MA2H or Fluke Multimeter 75 or 77
Chassis dynamometer	e.g. LPS 96 or LPS 002	0 680 017 001 0 680 100 200

7. Important general information

Be sure to observe information in order to prevent damage to transmission, engine and control unit and in order to avoid risk to persons.

7.1 Never start engine without securely connected battery.

7.2 Incorrect polarity of supply voltage, e.g. through wrong connection of battery, may lead to destruction of control units.

7.3 Do not use a fast charger to start the engine.
Give starting assistance only with second 12 V battery and jump leads.

C A U T I O N. !
Due to non-standardized requirements of vehicle manufacturers for electronic products, we advise you. not to use 24 V batteries for starting assistance.
Follow vehicle owner manual.

7.4 Disconnect battery from vehicle electrical system b e f o r e fast-charging.
Follow operating instructions for fast charger.

7.5 Do not disconnect battery from vehicle electrical system with engine running.

7.6 Never disconnect or connect wiring-harness plugs of control units with ignition on.

7.7 Remove control unit at temperatures above 80°C (e.g. paint-drying installation).

7.8 Remove control unit before performing welding work (electric spot welding).

7.9 Transmission fluid
In automatic transmissions, even slight deviations from the specified fluid level or incorrect grade of fluid can lead to noticeable deterioration in quality of shifting. Major deviations may even lead to wrong shifting.

Trouble-shooting instructions : BMW-5028

BOSCH system : Motronic M 1.3

Make of vehicle : BMW

Basic microcard : KFZ-00.

TABLE OF CONTENTS

SPECIAL FEATURES

These trouble-shooting instructions, valid at the time of publication, apply to the following vehicle models:
*BMW 730i with/without cat. converter as of 6.88
Engine: 3.0 l / 6 cyl.
*BMW 735i, 635CSi with/without cat. converter as of 6.88
Engine: 3.5 l / 6 cyl.

* Motronic system M 1.3 with self-diagnosis.

* The fault memory can be read out using the Pocket System Tester KTS 300 (0 684 400 300) with the program module PPG 204 as of status 09.01.89.

  Note:
  Further diagnosis possibilities (actuator diagnosis etc), which would be feasible with newer program-module statuses, are not evaluated with these vehicles.

  Pay attention to operating instructions for KTS 300. Connection of the KTS 300 to the diagnosis socket in the vehicle is via the adapter lead 1 684 463 196 (BMW).

* As an alternative to the KTS 300, the self-diagnosis can be read out by way of a flashing code (not possible with all control units).

  Note: Flashing code output is not possible with all control units.

* The self-diagnosis test table is arranged according to fault code nos. indicated by the KTS 300.
  The "Fault indication" column sometimes contains two types of fault which are optionally indicated by the tester, e.g.:
  open circuit/short to ground (= 1st type of fault)
  short to positive (= 2nd type of fault)
* The fault memory is cleared when performing tester diagnosis by means of a special clearance command or - in the case of flashing-code diagnosis - by clearing the full-load switch for at least 10 seconds during output of the flashing code "End of output".

SPECIAL FEATURES (CONTINUED)

* 55-pole control unit with variant encoding.
  Important note:
  Refer to basic instructions for information which must be given when ordering control unit.

* Group injection: breakdown into 2 groups which inject at different times (except during warm-up phase and when accelerating).
  Synchronization by means of sensor on ignition cable of cyl.6).
  Group 1: cylinders 2,4,6
  Group 2: cylinders 1,3,5

* Adaptive lambda closed-loop control and tank ventilation with pulsed valve (in the case of cat.).

Information on trouble-shooting:

1. Adaptive lambda closed-loop control.
   Note:
   If the engine won't start following fault elimination (e.g. after replacement of lambda sensor, injection valves or elimination of leaks in intake system or exhaust system etc.), briefly (at least 10 min.) detach Motronic control-unit plug with ignition switched off. The adaption values are thus cleared. Then attempt to start again.

2. If the code for depriming the burglar alarm has been incorrectly entered or if there is a defect in the vehicle computer/burglar alarm, positive is switched to term. 38 of the Motronic control unit. The engine can then not be started.
   For rapid testing, disconnect vehicle computer and alarm system module and attempt to start again (no voltage at term. 38).

SPECIAL FEATURES (CONTINUED)

Information on self-diagnosis:

*The following applies to models with built-in fault lamp (CARB lamp) in the instrument panel (currently only US version; "Check Engine"): the CARB lamp must light up after switching on the ignition. It goes out again after starting the engine provided that there is no fault in the fault memory. If, on the other hand, a severe fault is present (a so-called exhaust gas-relevant fault; static or sporadic fault), the CARB lamp remains constantly on after starting the engine or lights up when the engine is running. The flashing-code fault output is effected via the "CARB lamp".

*On models where there is no built-in fault lamp in the instrument panel and in cases where there is no KTS 300 available, a lamp must be connected to term. 15 of the control unit for reading out the fault memory. For this purpose, the evaluation unit for flashing-code diagnosis KDAW 9980 is to be connected to the control-unit plug. The plug should not be detached, so as to avoid clearing the stored faults.
Only detach handle cover, do not lift off plug insert.
Connect up KDAW 9980 as follows:
Socket 1 (red) to battery positive (term. 30).
Socket 2 (black) to Motronic control unit term. 15 (use suitable test prod).
Do not connect sockets 3 and 4.

*Initiation (stimulation) and continuation of the flashing-code fault output is effected by actuating the full-load switch 5 times (accelerate to full throttle 5 times within 5 seconds with ignition switched on). Each flashing code is output repeatedly until further switching is effected.
The last step is the appearance of the flashing code 0 0 0 0 or 1 0 0 0 = End of output.

*Switch off ignition to terminate self-diagnosis.

STRUCTURE, USAGE

These brief instructions essentially comprise vehicle-specific special features and test specifications (set values).

In line with the customer complaint, the trouble-shooting chart leads to various causes/component faults.
A detailed description of trouble-shooting is given in the trouble-shooting chart in the basic instructions.
NOTE: Even if reference is made to basic instructions, the set values, terminal assignments and special features indicated in these vehicle-specific brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

Pay attention to information given in basic instructions so as to avoid endangering people and in order to prevent damage to engine, trigger boxes, control units or ignition system.

IMPORTANT!
Heavy duty ignition system with hazardous high and low voltage!

Coming into contact with components or terminals which carry voltage may be fatal (on both primary and secondary sides).

* Injection and high-voltage flashovers are to be avoided when testing compression.
  The main relay is therefore to be detached.

TROUBLE-SHOOTING CHART

Customer complaint (fault symptoms)

1. Starting motor operates, engine fails to start or starts only with difficulty.	2. Engine starts but then dies.	3. Idle problems (engine speed, exhaust gas).	4. Poor throttle take-up, flat spot during acceleration.	5. Engine missing (ignition, injection).	6. Maximum engine power/top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
*	*	*	*	*	*	*	*	*	*	*	Self-diagnosis
*											Voltage at control unit
*											Engine-speed/reference-mark sensor
*		*			*	*					Fuel pressure
					*				*		Fuel delivery
*		*			*	*	*				Solenoid-operated inj. valve(s)
		*	*								Idle signal (with EPC)
					*						Full-load signal (with EPC)
		*	*								Idle contact (no EPC)
					*						Full-load contact (no EPC)
	*	*	*	*	*	*					Air-flow sensor
*	*	*	*								Air intake system
		*									Idle speed, CO
*		*		*	*						Ignition coil
*		*	*	*	*						Primary signal
		*	*	*	*	*					Secondary pattern
*	*	*	*		*	*		*	*		Ignition angle
*				*							H.T. sensor
		*									Overrun cutoff
		*	*	*							Interference-suppression resistors
				*	*						Interference
		*	*				*				Tank ventilation
		*	*		*						Lambda closed-loop control
*	*	*	*	*	*	*		*	*	*	Motronic control unit
		*			*						EPC (if provided)
				*							ETC (if provided)

SELF-DIAGNOSIS TEST TABLE

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions / Test conditions	Terminals	Set values
Data exchange not possible	—	——	Prerequisite for fault output: leads between control unit and diagnosis unit/fault lamp (flashing code) and voltage supply for control unit O.K. Note: Fault lamp is currently only installed in instrument panel on US models (CARB lamp).	13 55 15	——
Control unit Digital sec.(comput) defective	01	1211	Control unit defective.	——	——
Relay Fuel pump Op.circ/sh. to grnd. Short to B+	03	1261	Fault 1: open circuit (Op.circ) or short circuit to ground (sh. to grnd.) Fault 1 is only detected if other output stages are defective. Fault 2: short to positive (B+). Detach pump relay and measure voltage (with respect to ground) in frame (term. 86) with ignition on: Resistance of relay coil (term. 85/86): Check lead to control unit (term. 3).	3	10....15 V approx. 50...150 Ω
Idle actuator ZWD Winding 1/EWD Op.circ/sh. to grnd. Short to B+	04	1262	Fault code 4 refers to current path from control unit term. 4 to idle actuator term. 3. Check leads and plug connection of actuator for open circuit (Op.circ), short circuit to ground (sh. to grnd.) and short to positive (B+). Winding resistance of winding 1 of actuator at + 15 ... + 30° C between connections 3 and 2: Note: idle actuator only on models with no EPC.	4	17... 23 Ω
Valve Tank ventilation Op.circ/sh. to grnd. Short to B+	05	1263	Only CAT models have a tank ventilation valve. Check lead for contact with ground or positive. Valve winding resistance at +15...+30°C: Control unit is defective if lead and valve are O.K.	5	35... 55 Ω

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions / Test conditions	Terminals	Set values
Air-flow sensor/ Air-mass sensor Signal too low Signal too high	07	1215	Signal too low: check lead to air-flow sensor term. 2 (signal) and term. 3 (approx. +5V) for open circuit and short circuit to ground. Signal too high: check lead to air-flow sensor term. 2 for short to positive (+5V or +12V) and ground lead (term. 4) for open circuit. Check resistances at air-flow sensor: between term. 2 and term. 4 (deflect sensor flap): between term. 3 and term. 4: Measure wiper voltage at term. 2 to term. 4 with plug attached and ignition on (sensor flap in off position Slowly deflect sensor flap as far as full load:	7(S)* 12(+) 26(-)	——— 8...2500 Ω 500...1100 Ω 0,2... 0,3 V greater than 4,2 V
Lambda control outside min. range outside max. range	10	1222	Check CO content (ahead of catalytic converter). Check intake system and exhaust system for leaks. Incorrect fuel pressure. Sensor defective. Injection valve(s) clogged or not functioning. Note: applies only to CAT models.	———	———
Fault lamp Op.circ/sh. to grnd. Short to B+	15	———	Check lead to fault lamp for short circuit to ground (sh. to grnd.) and short to positive (B+). Open circuit (Op.circ) is not detected! Note: fault lamp is currently only installed in instrument panel of US models (CARB lamp).	15	———
Injectors (Group 2) Op.circ/sh. to grnd. Short to B+	16	1251	Fault: short circuit to ground (sh. to grnd.), to positive (B+) or open circuit (Op.circ) in joint positive/negative lead. Check injection valves of cyl. 1, 3, 5 for short circuits or open circuits. Control unit is defective if injection valves and leads are O.K. Note: open circuits in individual injection valves are not detected by the self-diagnosis.	16	4,8... 5,8 Ω (3 valves in parallel) 14,5...17,5 Ω (1 injection valve)

*) S = Signal

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions / Test conditions	Terminals	Set values
Injectors (Group 1) Op.circ/sh. to grnd. Short to B+	17	1252	Fault: short circuit to ground (sh. to grnd.), to positive (B+) or open circuit (Op.circ) in joint positive/negative lead. Check injection valves of cyl. 2, 4, 6 for short circuits or open circuits. Otherwise trouble-shooting as for fault code 16.	17	4,8... 5,8 Ω (3 valves in parallel) 14,5...17,5 Ω (1 injection valve)
Idle actuator ZWD Winding 2 Op.circ/sh. to grnd. Short to B+	22	1262	Fault code 22 refers to current path from control unit term. 22 to idle actuator term. 1. Check leads and plug connection of actuator for open circuit (Op.circ), short circuit to ground (sh. to grnd.) and short to positive (B+). Winding resistance of 2nd winding of actuator at +15...+30°C between connections 1 and 2: Note: idle actuator only on models with no EPC.	22	19...25 Ω
Lambda sensor Open circuit Short to ground Short to B+	28	1221	Check lead for open circuit (Op.circ), short circuit to ground and short to positive (B+). Pay attention to worn insulation! Sensor heater defective. Sensor clogged. Note: applies only to CAT models.	28	———
Speed signal incorrect/no signal	29	———	Check lead from Motronic term. 29 to instrument cluster for open circuit, short circuit to ground and short to positive. Continue trouble-shooting in instrument cluster if leads and plug connections are O.K. Note: term. 29 is not used on models with EPC.	29	———
Battery voltage too low too high	37	1231	Supply voltage for control unit too low: Check voltage dips at positive and ground terminal. Charge battery. Supply voltage for control unit too high: Check alternator regulator.	18 19 (+) (−)	greater than 9 V (with engine running) less than 16 V (with engine running)

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions / Test conditions	Terminals	Set values
ASR/MSR interface Short to B+	38	——	Check lead between Motronic and ABS/ETC (ASR/MSR) control unit (if provided) or burglar alarm for short to positive (B+). Continue trouble-shooting with ETC or burglar alarm if leads and plug connections are O.K.	38	——
Air-temp. sensor Op. circ./sh. to B+ Short to ground	44	1224	Check temperature sensor and lead for open circuit, (Op. circ), short to ground and short to positive (B+). Temperature-sensor resistance at +15...+30°C:	44	1450...3300 Ω
Engine temp. sensor Op. circ./sh. to B+ Short to ground	45	1223	Check temperature sensor and lead for open circuit, (Op. circ), short circuit to ground and short to positive (B+). Temperature-sensor resistance at +15...+30°C: at approx. +80°C:	45	1450...3300 Ω 280... 360 Ω
Transmission intervention Short to ground	51	1278	Check lead for short circuit to ground or corresponding output in transmission control unit (term. 24) defective. Note: fault 51 applies to models with electronic transmission control (GS); term. 51 must be open on models with no transmission control.	51	——
Idle switch Short to ground	52	1232	Models with EPC: Fault 1: short circuit to ground in lead to EPC control unit term. 4 or lead between EPC control unit term. 4 and pedal position sensor. Fault 2: EPC control unit defective (defective output stage). Models with no EPC: Fault: idle contact (in throttle-valve switch) permanently closed or short circuit to ground in lead. Idle contact closed in off position: Actuate throttle valve somewhat:	52	—— approx. 0 Ω infinity Ω

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions / Test conditions	Terminals	Set values
Full-load switch Short to ground	53	1233	Models with EPC: Fault 1: short circuit to ground in lead to EPC control unit term. 28. Fault 2: EPC control unit defective (defective output stage). Models with no EPC: Fault: full-load contact (in throttle-valve switch) permanently closed or short circuit to ground in lead. Full-load contact closed in full-throttle position: Release accelerator pedal somewhat:	53	——— approx. 0 Ω infinity Ω
Converter clutch/ Driving pos. switch Comparison not O.K.	54 (24)	———	Note: fault code 24 corresponds to fault code 54 Check lead between Motronic term. 54 and transmission control term. 25 for short circuit to ground. Continue trouble-shooting with transmission control if lead is O.K.	54	———
CU output stages with fin.cntling el. defective	100	———	CU = control unit. Check following components and leads for open circuit, short circuit to ground and short to positive: Injection valves, fuel-pump relay, purge control valve, fault lamp (US only)	16 17 3 5 15	———
No fault stored	—	1444	Continue trouble-shooting with trouble-shooting chart.	———	———
———	—	1000	End of output (flashing code only)	———	———

Pressure regulator	
Fuel pressure	3,0 l: 2,8...3,2 bar 3,5 l: 2,8...3,2 bar
Electric fuel pump	
Delivery (measured in return):	min. 950 cm^3 /30s
Supply voltage (under load):	min. 12 V
Temperature sensor (air)	
Internal resistance measured at air-flow sensor between term. 1 and term. 4	
at ambient temperature (+15°C...+30°C):	1450...3300 Ω
Temperature sensor (engine) (plug color blue)	
Internal resistance	
at + 15° C...+ 30° C :	1450...3300 Ω
with engine at operating temp. (approx. + 80° C):	280... 360 Ω
Solenoid-operated injection valve	
Internal resistance at ambient temperature (+ 15° C...+ 30° C):	14,5...17,5 Ω
Air-flow sensor	
Internal resistance between	
term. 2 and term. 4 :	8...2500 Ω (*)
term. 3 and term. 4 :	500...1100 Ω

(*) Slowly deflect sensor flap as far as it will go. Fluctuating increase in resistance with slight decrease towards end.

Engine-speed/reference-mark sensor		
Internal resistance between term. 1 and term. 2 at ambient temperature (+15°C...+30°C):		400...800 Ω
Air gap:		0,8 ± 0,5 mm
Throttle-valve switch		
Resistance value of idle contact term. 1 (6)* and term. 2 (4)* :	Approx.	0 Ω
Resistance value of full-load contact term. 3 (5)* and term. 2 (4)* :	Approx.	0 Ω
Idle actuator		
Internal resistance at +15°...+30°C between		
term. 1 and term. 2 :		19...25 Ω
term. 3 and term. 2 :		17...23 Ω
Lambda sensor		
Resistance value of heater winding (sockets 3 and 4 in 4-pole pin terminal for lambda sensor) :		1...15 Ω
Ignition coil		
Primary resistance:	Approx.	0,4 Ω
Secondary resistance:		
Rod-type coil		4300... 7700 Ω
Plastic coil (new)		6500...11500 Ω
Interference-suppression resistors		
High-voltage distributor rotor:		1 k Ω
High-voltage distributor domes:	Each	1 k Ω
Spark-plug connectors:	Each	5 k Ω
Spark plugs:		5 k Ω
Ignition coil:		1 k Ω

*) Value in brackets applies to version with electronic transmission control

High-voltage sensor:
Internal resistance
between term. 1 and term. 2: Approx. 0,2...1 Ω

Tank ventilation valve:
(only in vehicles with catalytic converter)
Internal resistance at
ambient temperature (+15°C...+30°C): 35...55 Ω

Idle test:
Engine at operating temperature,
switch off loads.

Idle speed 3,0 l: 800 ± 50 min $^{-1}$
3,5 l: 800 ± 50 min $^{-1}$

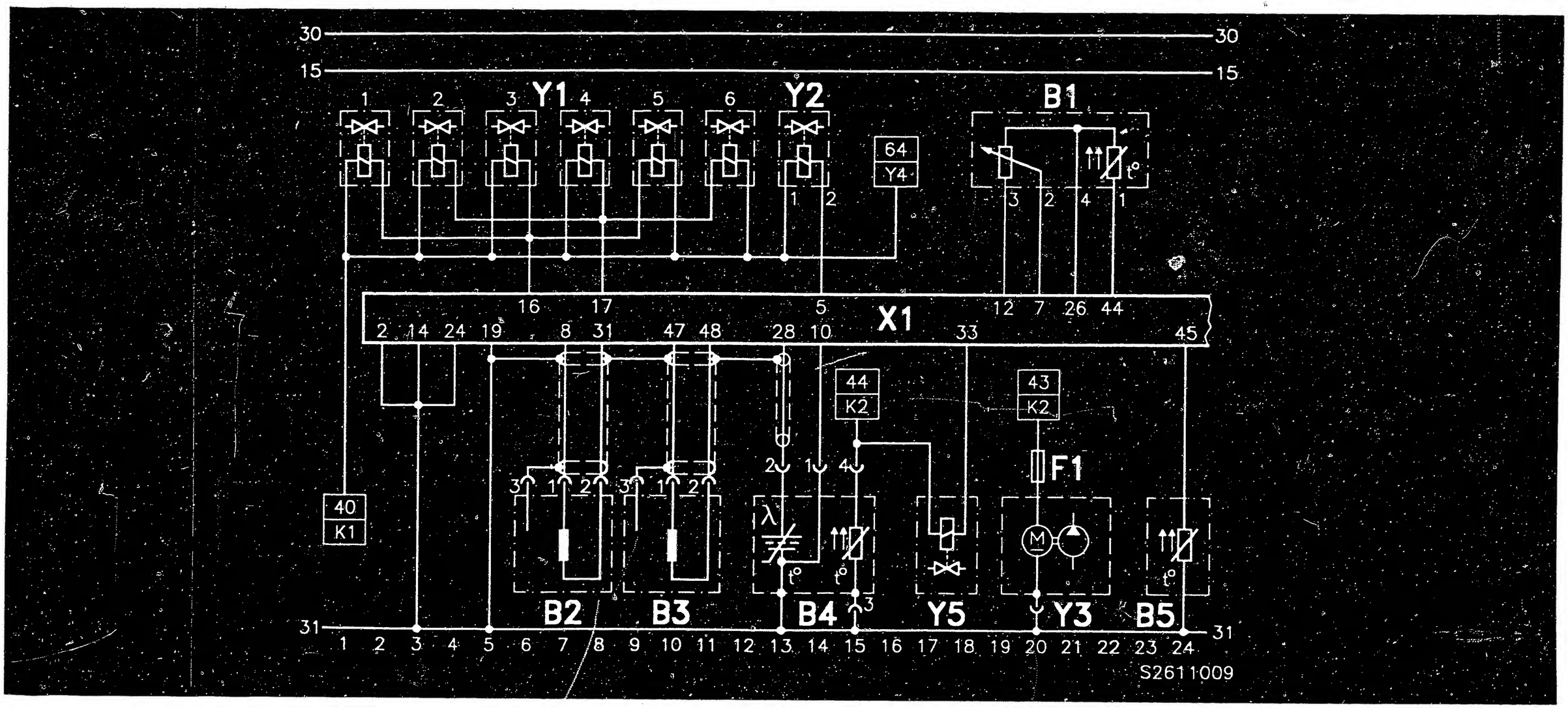
Ignition angle 3,0 l: 10 ± 5° CS
3,5 l: 10 ± 5° CS
(Automatic transmission on N or P)

CO content:
without catalytic converter: 1,0 ± 0,5 vol.% CO
Adjust mixture at bypass screw in
air-flow sensor:
Turning in an anti-clockwise direction
produces leaner mixture,
turning in a clockwise direction
produces richer mixture.

Vehicles with catalytic
converter: 0,7 ± 0,5 vol.% CO
(Measure CO ahead of catalytic converter)

Please refer to equipment and Autodata microcard for settings as regards valve clearance and other engine-related data.

For production reasons:
continued on the following
coordinate.



ELECTRICAL TERMINAL DIAGRAM

B1 = Air-flow sensor
B2 = H.T. sensor
B3 = Engine-speed/reference-mark sensor
B4 = Heated lambda sensor (cat)
B5 = Temperature sensor (engine)
F1 = Pump fuse

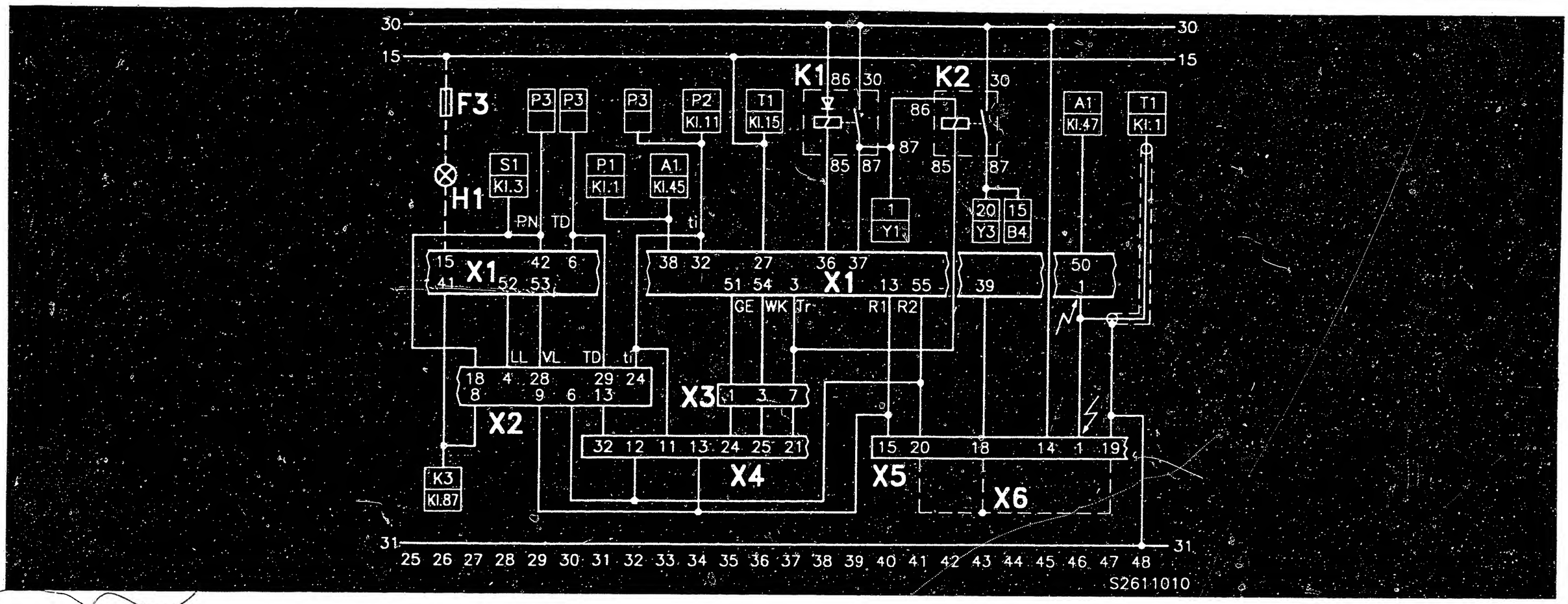
K1 = Main relay
K2 = Pump relay
X1 = Motronic control unit plug
Y1 = Solenoid-operated injection valves

Y2 = Tank ventilation valve (cat only)
Y3 = Electric fuel pump
Y4 = Idle actuator (on models with no EPC)
Y5 = Solenoid valve for downshift block in transmission trigger box *

*) Only on automatic transmission with hydraulic control

J21 ⟹

J22 ⟺



ELECTRICAL TERMINAL DIAGRAM (CONTINUED)

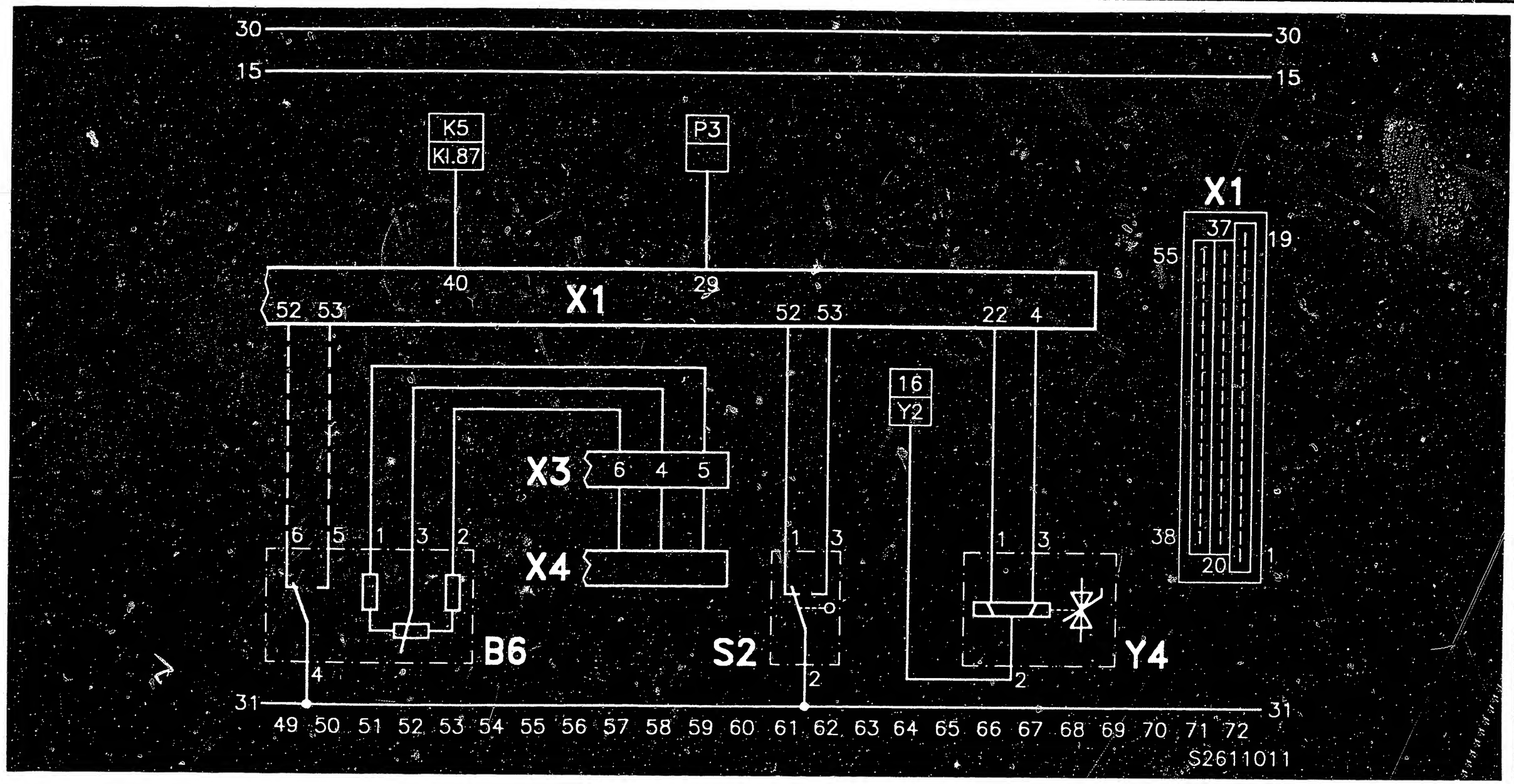
A1 = ABS/ETC control unit (if ETC* provided)
B1 = Air-flow sensor
B4 = Heated lambda sensor (cat)

F3 = Fuse
H1 = "CARB" lamp (fault lamp; US version only)
K1 = Main relay
K2 = Pump relay
K3 = A/C relay (if A/C provided)
P1 = Burglar alarm
P2 = Vehicle computer
P3 = Instrument cluster
R1 = Stimulation lead
R2 = Serial interface
S1 = Driving position switch (automatic)
T1 = Ignition coil
X1 = Motronic control-unit plug
X2 = EPC control-unit plug (model with EPC)
X3 = Plug connection to GS control unit**
X4 = GS control-unit plug (model with GS **)
X5 = Diagnosis unit
X6 = Jumper in diagnosis-unit cover

LL = Idle signal
VL = Full-load signal
TD = Engine speed
ti = Injection time
GE = Gear mesh
WK = Converter clutch
Tr = Engine speed signal for GS
PN = Park / Neutral

*) ETC = Electronic Traction Control (BMW designation: ASC = Automatic Stability Control)
**) GS = Transmission Control

J23 — J24



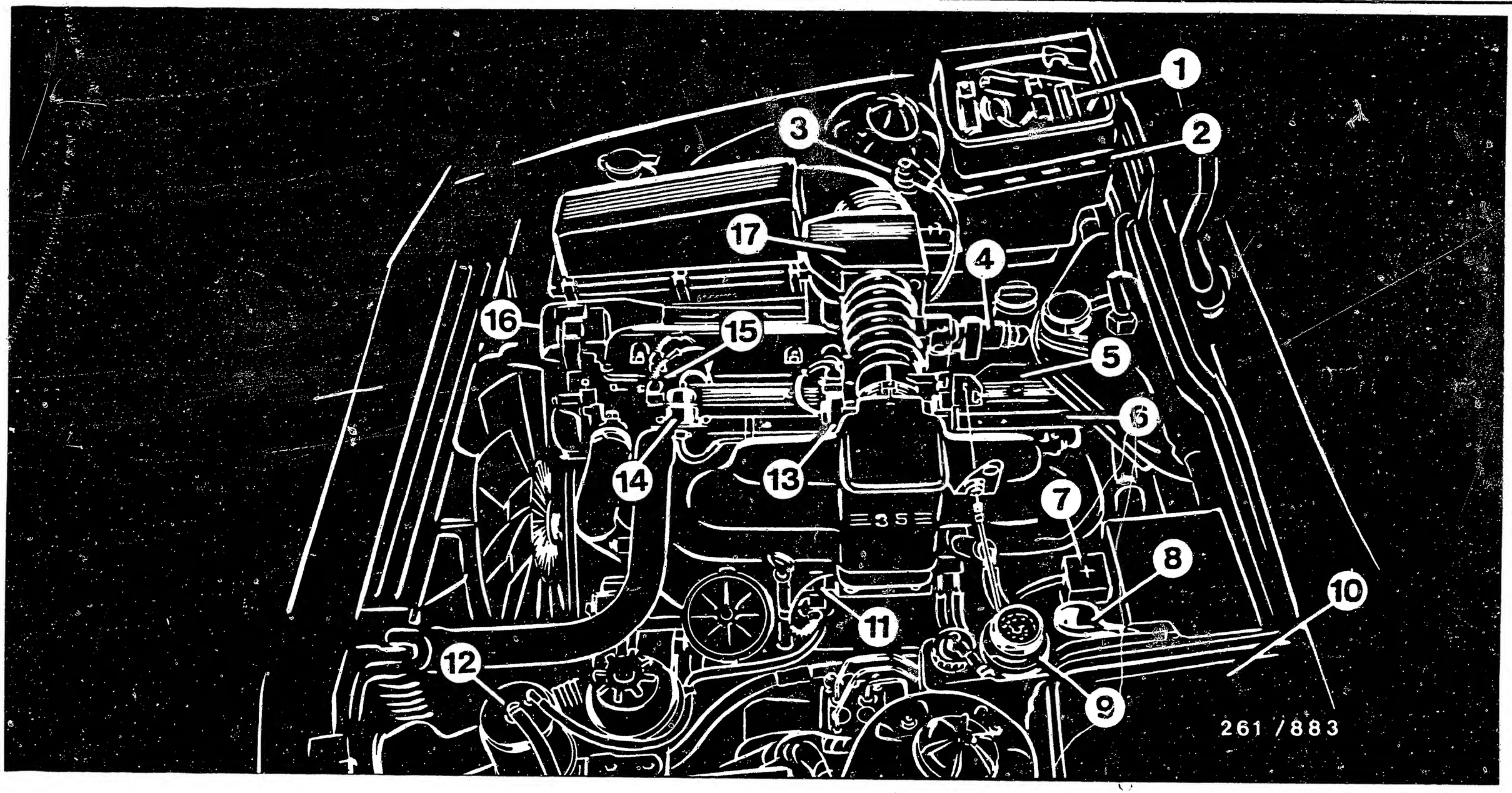
ELECTRICAL TERMINAL DIAGRAM (CONTINUED)

B6 = Throttle-valve switch with potentiometer
on models with no EPC
(for item S2 on models with transmission control)
K5 = A/C compressor relay (if A/C provided)
P3 = Instrument cluster
S2 = Throttle-valve switch for models with no EPC
(for item B6 on models with manual transmission)

X1 = Motronic control-unit plug
X3 = Plug connection to GS control unit
X4 = GS control-unit plug
(with transmission control)
Y2 = Tank ventilation valve (cat only)
Y4 = Idle actuator
(on models with no EPC)

J25 — <⟹>

J26 — <⟸



INSTALLATION POSITION OF COMPONENTS

1= Motronic control unit
2= Motronic ground terminal (beneath cover)
3= Ignition coil
4= Idle actuator
5= Cover over solenoid-operated injection valves
6= Fuel distributor
7= Battery positive terminal
8= Engine plug
9= Diagnosis unit
10= Fuse box
11= Tank ventilation valve
12= Active-carbon container
13= Throttle-valve switch
14= Fuel pressure regulator
15= Temperature sensor (engine)
16= H.T. distributor
17= Air-flow sensor

Trouble-shooting instructions : AUD-5006

BOSCH system : KE-Motronic

Make of vehicle : AUDI

Basic microcard : KFZ-00.

TABLE OF CONTENTS

SPECIAL FEATURES

These trouble-shooting instructions, valid at the time of publication, apply to the following AUDI models:

AUDI 80 / AUDI 4000 USA/California,
with 2.0 l / 4-cyl. engine, 83 kW
Engine code letters 3A, Year of manufacture 09.87->

KE-Motronic, system version MK 1.1.

This system with common control unit has to a great extent the same functions as the KE 3-Jetronic with an EI-K ignition system. The fuel-injection unit corresponds exactly to that of the KE-Jetronic with regard to the mechanical and hydraulic parts of the system.

Alongside the basic functions of fuel injection and ignition, the system has further additional functions:

* Lambda closed-loop control with adaptive basic adaptation (automatic compensation of basic faults).
* Low-idle-speed control.
* Knock control.
* Electronically controlled tank ventilation.
* Self-diagnosis with fault memory.

SPECIAL FEATURES

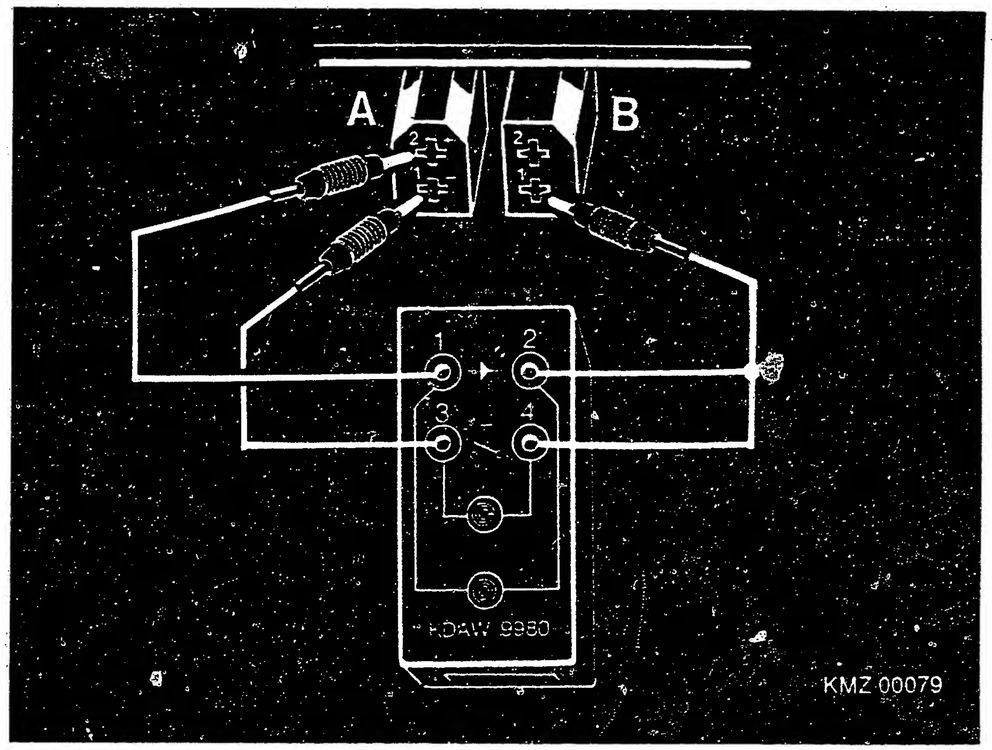
Alterations to self-diagnosis as of Model 1988:

* Activation of self-diagnosis no longer possible at fuel pump relay.

* Special test connection in area of mixture-control unit for connection of diagnosis lamp dispensed with.

For activation and evaluation of the self-diagnosis, there are two diagnosis connectors for connection of the diagnosis evaluation unit KDAW 9980 or a diode test lamp on the driver's side in the footwell above the pedals.

Refer to following coordinate for assignment of diagnosis connectors and connection of evaluation unit.



A = Black connector for voltage supply

B = Red (Model 1988) or brown (as of Model 1989) diagnosis connector. Upper connection not used.

SPECIAL FEATURES

Illustration shows arrangement and assignment of connectors and connection of diagnosis evaluation unit KDAW 9980.

N o t e :
Check arrangement of connectors and assignment if applicable, since not always in line with Fig.

There have been no changes to the self-diagnosis, fault-storage, activation-time and fault-clearance functions and these are in line with the description given in the basic microcard.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

TROUBLE-SHOOTING CHART

Customer complaint (fault symptoms)

1. Starting motor operates, engine fails to start or starts only with difficulty.	2. Engine starts but then dies.	3. Idle problems (engine speed, exhaust gas).	4. Poor throttle take-up, flat spot during acceleration.	5. Engine missing (ignition, injection).	6. Maximum engine power/top speed not reached.	7. Fuel consumption too high.	8. Engine running on.	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
*	*	*	*	*	*	*	*	*	*	*	Self-diagnosis
*		*	*		*						Induction system
*	*	*	*		*			*	*		Voltage supply, control unit
*	*			*	*						Electric fuel pump
*	*	*	*				*				Air-flow sensor
*		*				*					Cold-start valve
*	*			*	*						Primary pressure
*	*	*	*	*	*	*					Differential pressure
*											Fuel system leaking
*	*	*	*	*	*		*				Injection valves
*	*	*	*		*	*					Fuel distributor
*		*			*						Throttle valve
*	*	*	*		*	*					Temperature sensor (engine)
		*	*								Throttle-valve switch (idle)
					*			*	*		Throttle-valve switch (full load)
		*	*		*						Lambda closed-loop control
*	*	*	*			*					Exhaust-gas adjustment
		*									Low-idle-speed control

TROUBLE-SHOOTING CHART (CONTINUED)

Customer complaint (fault symptoms)

1. Starting motor operates, engine fails to start or starts only with difficulty.	2. Engine starts but then dies.	3. Idle problems (engine speed, exhaust gas).	4. Poor throttle take-up, flat spot during acceleration.	5. Engine missing (ignition, injection).	6. Maximum engine power/top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
*											Starting enrichment
	*										Post-start enrichment
	*	*	*								Warm-up enrichment
			*								Acceleration enrichment
			*		*				*		Full-load enrichment
						*					Overrun cut-off
							*				Tank-ventilation system
*				*							Ignition high-voltage side
*				*							Ignition coil
*		*									Firing order
*											Voltage, magnetic pulse generator
*											Magn. pulse generator, operation
*											Control-unit operation, ignition
*											Voltage, trigger box
*											Primary signal
				*							Voltage, ignition coil
*											Ignition distributor - installation adjustment
*					*	*	*	*	*	*	Basic ignition setting

SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Testing of component/function	Test instructions/ test conditions	Terminals	Set values
1 1 1 1	Control unit	This fault is indicated by steady lighting of the diagnostic lamp while the vehicle is being driven. Exchange control unit without any further testing.	— —	— —
2 1 1 3	Magnetic pulse generator defective or open circuit between control unit and magnetic pulse generator	Engine cannot be started. Switch on ignition. Voltage measurement at cable connector of ignition distributor: Test sensor signal (idle speed):	3 1 (+)(−) 2 1	at least 10 V Rectangular pulse
	Air-flow sensor plate sticks in rest position	It may be possible to start the engine. Check centring and freedom of movement of air-flow sensor plate.	— —	— —
2 1 2 1	Idle-speed throttle-valve switch or lead defective	Idle-speed throttle-valve switch constantly closed. Lead to ECU terminal 28 is short-circuited to ground. Switch setting incorrect. Resistance measurement at plug: throttle valve closed: throttle valve open : Setting of switching point:	1 2	Approx. 0 Ω Infinity Ω 0.15 ... 0.5 mm
2 1 2 3	Full-load throttle-valve switch or lead defective	Full-load throttle-valve switch constantly closed. Lead to ECU terminal 31 is short-circuited to ground. Setting incorrect. Resistance measurement at plug: throttle valve closed: throttle valve open : Setting of switching point:	2 3	Infinity Ω Approx. 0 Ω 8 ... 12° before full load

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Fault indication Flashing code	Testing of component/function	Test instructions/ test conditions	Termin-als	Set values
2 1 4 1	Knock-control limit reached.	As engine knock occurs, spark-advance angle is retarded by a specific amount and then subsequently advanced again slowly. Diagnostic lamp lights during the period of maximum retardation. Check basic ignition setting and correct if necessary. Test specification: Setting: Idle adjustment incorrect. Further possible causes: fuel quality, shielded lead of knock sensor damaged, engine damage.	 — — — —	 4...8° before TDC 5...7° before TDC
2 1 4 2	Knock sensor defective or open circuit in lead or contact resistance	Fault detection as of an engine speed of approx. 2650min $^{-1}$. After time lag, a steady lighting of diagnostic lamp until engine is switched off. Check leads from control unit to knock-sensor plug-in connection for open circuit: Check cable connector of knock sensor for short circuit to ground: Tightening torque, knock sensor:	 6 1 8 2 8 3 1 2 — —	 Approx. 0 Ω Approx. 0 Ω Approx. 0 Ω Infinity Ω 15...25 Nm
2 2 3 1	Low-idle-speed control not within the operating range	Possible causes: Basic adjustment of throttle valve. Induction system (e.g. unmetered air). Basic ignition setting incorrect.	— —	— —

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

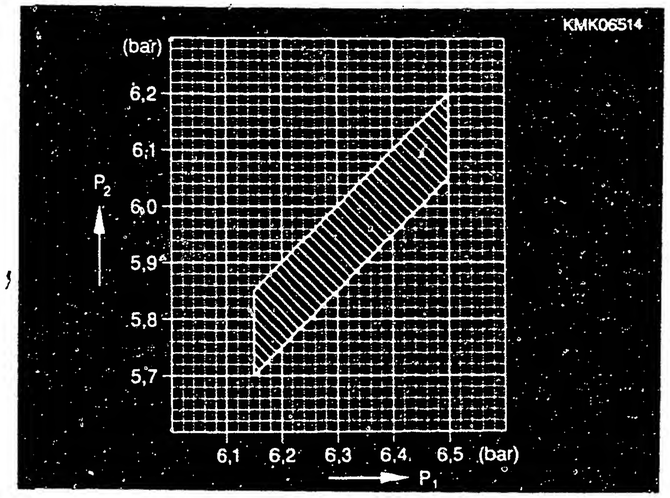
Fault indication Flashing code	Testing of component/function	Test instructions/ test conditions	Terminals	Set values
2 2 3 2	Potentiometer in air-flow sensor defective or open circuit in lead	Voltage measurements at cable connector of potentiometer (with auxiliary leads). Switch on ignition. Supply: Signal (deflect air-flow sensor plate): Disconnect control-unit plug and test leads 35, 23 and 26 to plug of potentiometer for: * Open circuit: * Short circuit to ground:	 1 3 2 3 (+) (-) 35 3 23 2 26 1 8,23,26	 4,35 ... 5,35 V Voltage increase Approx. 0 Ω Approx. 0 Ω Approx. 0 Ω Infinity Ω
2 3 1 2	Temperature sensor (engine) or lead defective	Check resistance value at temperature sensor (NTC): Engine cold (+15 ...+30° C): Engine at normal operating temperature (+80°C): Check leads from control unit to NTC for: * Open circuit: * Short circuit to ground:	 — — — — 3-NTC 35-NTC 3, 35	 1300...3600 Ω 250... 390 Ω Approx. 0 Ω Approx. 0 Ω Infinity Ω
2 3 4 1	Lambda closed-loop control not within operating range (control limits exceeded or fallen below)	Fault occurs only in idle/part-load range. Indicated by diagnostic lamp if fault has been present for at least 2 minutes. Possible causes of trouble: * Lambda closed-loop control not or incorrectly functioning, short circuit in sensor lead, lambda-sensor heater defective. * Cold-start valve leaking. * Induction system leaking (unmetered air). * Tank-ventilation valve constantly open. * Idle adjustment incorrect.	— —	— —

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

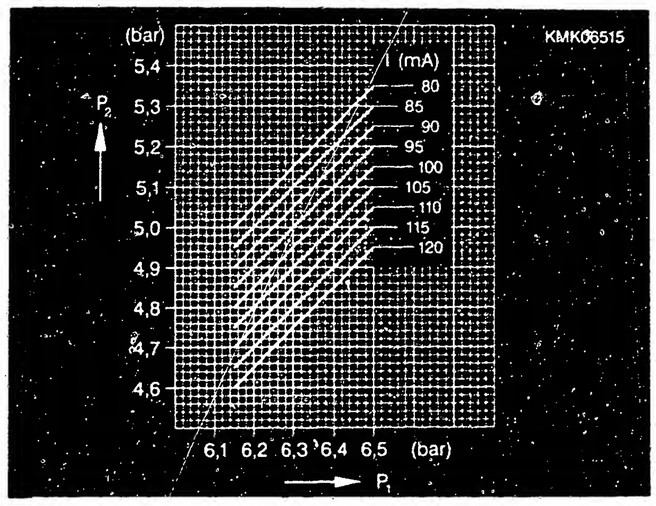
Fault indication Flashing code	Testing of component/function	Test instructions/ test conditions	Termin-als	Set values
2 3 4 2	Lambda sensor or sensor lead defective	Fault is detected when engine at normal operating temperature and in range between idle and approx. 3500 min $^{-1}$ and is indicated by diagnostic lamp. * Resistance value of lambda sensor, Cold: Hot: * Test for open circuit in lead:	7-grnd " 7	> 20 k Ω < 2 k Ω Approx. 0 Ω
2 3 4 3	Fuel mixture too lean (mixture control limit +10 mA exceeded).	Possible causes: * Induction system leaking (unmetered air). * Idle adjustment too lean.	— —	— —
2 3 4 4	Fuel mixture too rich (mixture control unit -5 mA fallen below).	Possible causes: * Cold-start valve leaking. * Idle adjustment too rich.	— —	— —
4 4 3 1	Low-idle-speed control not functioning	Possible causes: * Voltage supply (ignition term. 15) to idle actuator term. 2 open-circuited: * Open circuit in lead from control unit term. 17 to idle actuator term. 1 or short circuit to ground. Continuity: Short circuit to ground: * Idle actuator defective (open circuit): * Control unit defective, replace.	2-grnd 17 2 17-grnd 1 2	Battery voltage Approx. 0 Ω Infinity Ω 4...12 Ω
4 4 4 4	No fault detected	——— ———	— —	— —

TEST SPECIFICATIONS

NO.	Testing/Test condition	Set value	
1	Electric fuel pump – fuel delivery: Supply voltage (under load):	At least 1000 cm ^{3} /min At least 11,5 V	
2	Primary pressure:	6,15...6,5 bar	
3	Differential pressure: Take lower-chamber-pressure "warm" set value corresponding to the primary pressure measured from the top chart (actuator current 0 mA) Take lower-chamber-pressure "cold" set value corresponding to primary pressure and actuator current measured from bottom chart (tolerance ± 0,15 bar) Simulation of "cold" condition: Switch on ignition (peak coil current approx. 100 mA).		
4	Rate of flow, KE restriction:	130...150 cm ^{3} /min	
5	Leakage test – complete system: Minimum pressure after 10 mins: Minimum pressure after 20 mins:	 3,3 bar 3,2 bar	
6	Injection valves – opening pressure:	3,7...4,8 bar	
7	Fuel distributor – comparative measurement of fuel deliveries Actuator current 0 mA: Idle: Part load: Full load: Minimum delivery at max. deflection of air-flow sensor plate:	Setting (cm ^{3} /min) 6,0 40,0 100,0 120...150 cm ^{3}	Max. permiss. delivery (cm ^{3} /min) 6,6 42,5 109,0
8	Air-flow sensor plate – zero position (under basic position):	1,9...3,0 mm	
9	Air-flow sensor plate – travel:	0,1...2,0 mm	



p 1 = Primary pressure
p 2 = Lower-chamber pressure
I = Actuator



TEST SPECIFICATIONS (CONTINUED)

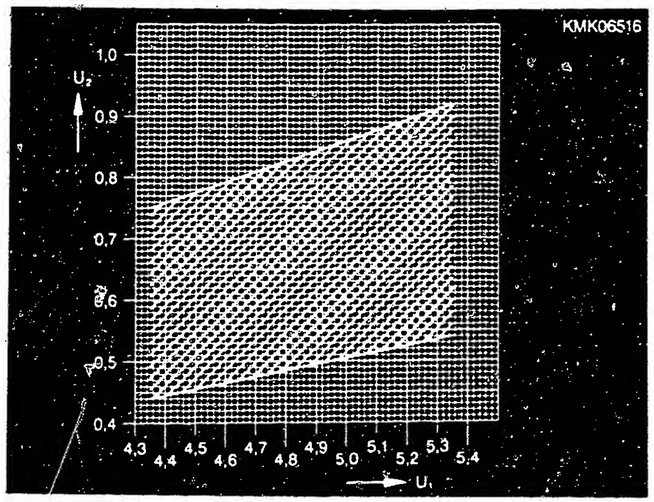
No.	Testing/Test condition	Set value
10	Idle-mixture-adjusting screw - basic setting dimension:	18,7...18,9 mm
11	Throttle-valve switch - switching-point settings: Idle switch - clearance, lever to stop: Full-load switch - switching point before full-load stop:	 0,15...0,5 mm 8... 12°
12	Resistance value, cold-start valve:	6...14 Ω
13	Resistance value, idle actuator:	4...12 Ω
14	Resistance value, tank-ventilation valves (both):	35...55 Ω
15	Resistance value, pressure actuator:	16...22 Ω
16	Resistance value, lambda-sensor heater:	1...15 Ω
17	Resistance value, fuel-temperature sensor (NTC): Engine cold (+15°C ... +30°C): Engine at norm. op. temp. (approx. +80°C):	 1300...3600 Ω 250... 390 Ω
18	Potentiometer in air-flow sensor (basic function) Supply voltage: Volt. signal; air-flow sensor plate in netral pos.: Voltage signal; air-flow sensor plate deflected: Check potentiometer setting if necessary:	 4,35...5,35 V 0...0,2 V Voltage increase See test specification No. 30
19	Test control-unit functions - injection unit: Peak coil current: Starting enrichment - engine at normal operating temperature: Post-start enrichment (corresp. to +20°C): * Start engine. Current value: * Current value constant for: * Afterwards, slow regulation to: Warm-up enrichment (corresp. to +20°C), lambda sensor disconnected, idle speed:	 85...115 mA 55... 65 mA 15... 23 mA 3... 6 s 9... 11 mA 9... 11 mA

TEST SPECIFICATIONS (CONTINUED)

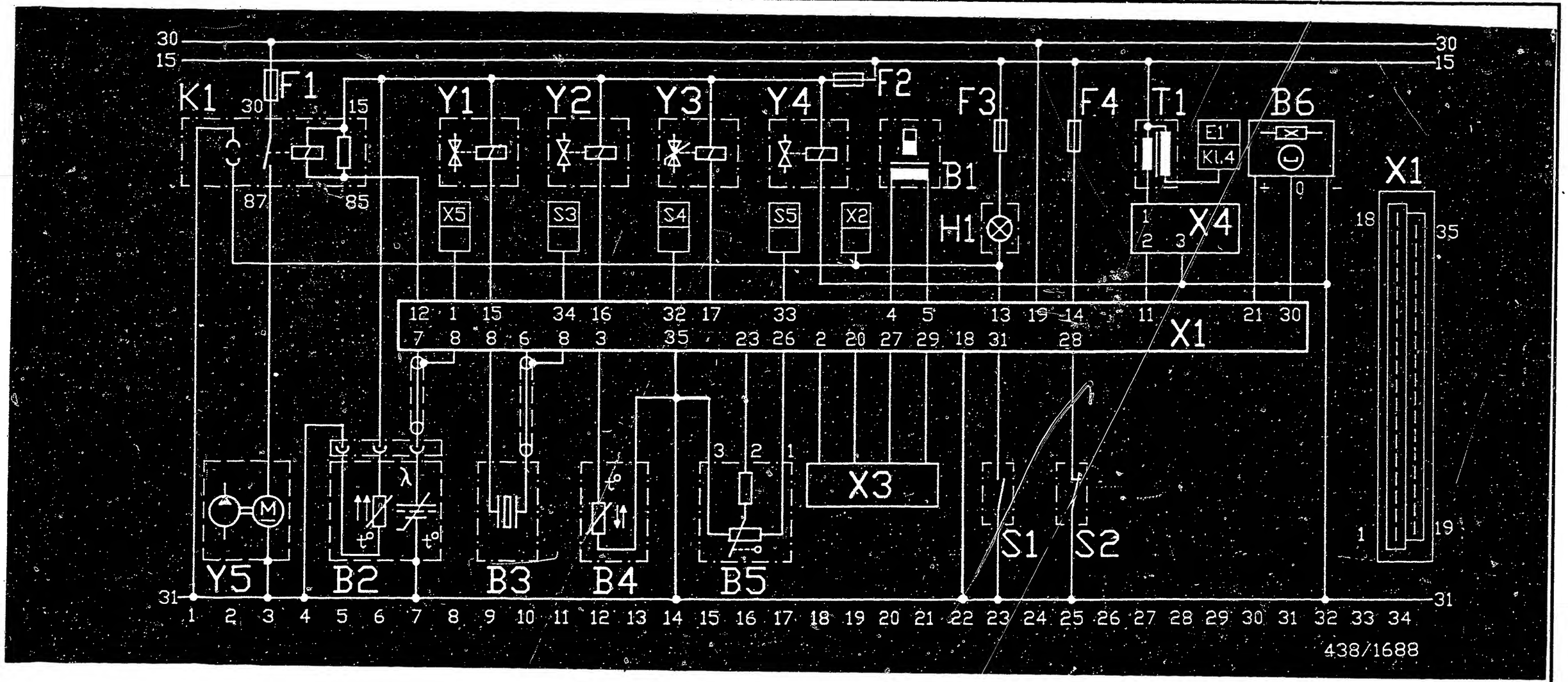
No.	Testing/Test condition	Set value
	Test control-unit functions – injection unit (continued):	
	Acceleration enrichment (corresp. to +20°C):	Current increase
	Full-load enrichment (engine at norm. op. temp.):	2...5 mA
	Overrun cut-off (engine at norm. op. temp.):	-40...-80 mA
20	Lambda closed-loop control:	
	Open-loop-control operation Switch off ignition. Disconnect negative terminal from battery and reconnect after 1 minute (this serves to clear memory). Disconnect lambda sensor. Start engine:	-1...+1 mA (static)
	Rich stop (sensor lead to ground) (heavily over-enriched, engine may stall):	Max. 23 mA
	Lean stop (sensor lead to 1.5 V) (excessively lean, engine may stall):	Max. -16 mA
	Closed-loop-control op. (lambda sensor connected):	0...5 mA (pulsating)
21	Resistance value, lambda sensor. Cold: Hot:	> 20 k Ω < 2 k Ω
22	Ignition coil – resistance values: Primary: Secondary	0,6...1,0 Ω 6,4...11,1k Ω
23	Control-unit function – ignition at idle speed:	Rectangular pulse
24	Voltage supply, trigger box (output stage):	Battery voltage
25	Voltage supply, ignition coil under load:	At least 10 V
26	Ignition – basic setting: Test specification: Setting:	4...8° before TDC 5...7° before TDC

TEST SPECIFICATIONS (CONTINUED)

No.	Testing/Test condition	Set value
27	Knock sensor – tightening torque:	15...25 Nm
28	Firing order:	1 – 3 – 4 – 2
29	Idle adjustment: Test and setting conditions: * First of all eliminate all faults detected by self-diagnosis. * Exhaust system between cylinder head and catalytic converter must be absolutely leak-tight * Basic ignition setting O.K. * If resetting necessary: remove closure cap from activated-carbon canister, pull off crankcase hose from cylinder head and breather housing and seal off. Idle-speed check value (not adjustable): Speed increase with air conditioner "on" by: CO check value (not adjustable): Pressure-actuator activation current in closed-loop control operation	 780...900 min $^{-1}$ Approx. 70 min $^{-1}$ 0,3...1,2 by vol. % 0...5 mA
30	Signal of potentiometer in air-flow sensor (measurement necessary only if poor idle or part-load performance): Measure supply voltage at potentiometer term. 1 (+) and 3 (–) and note down: Measure voltage signal of potentiometer at term. 2 (+) and 3 (–) with engine at normal operating temperature and at idle speed and compare with chart opposite.	 4,35...5,35 V See chart



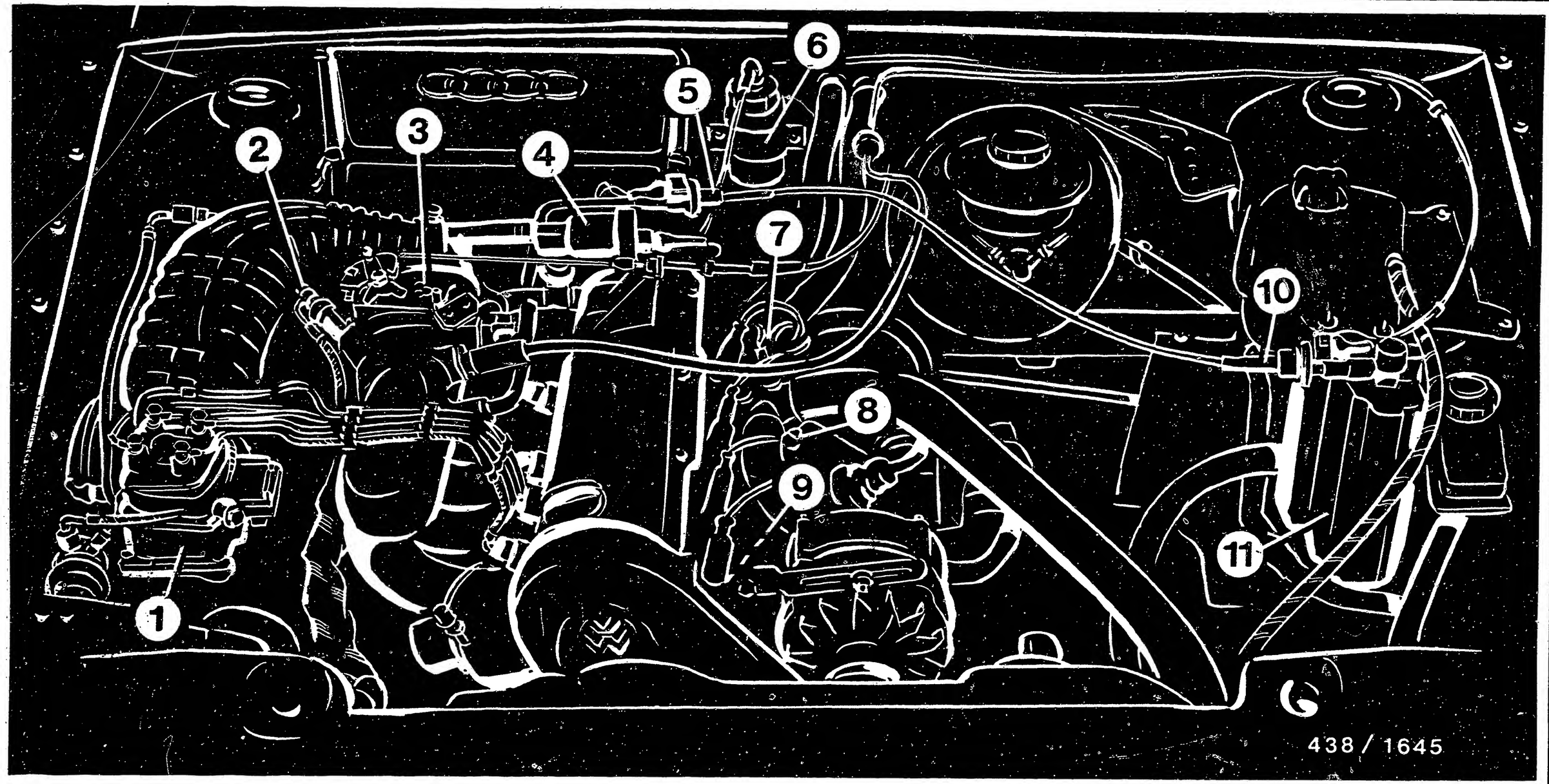
U_1 = Supply voltage, potentiometer
U_2 = Potentiometer voltage signal



B1 = Pressure actuator
B2 = Lambda sensor
B3 = Knock sensor
B4 = Temperature sensor (engine)
B5 = Air-flow-sensor potentiometer
B6 = Hall generator
E1 = Ignition distributor
F1 = 15 A fuse
F2 = 15 A fuse
F3 = 15 A fuse
F4 = 10 A fuse
H1 = Diagnostic lamp (California model only)
K1 = Electric-fuel-pump relay with contacts for triggering diagnosis
S1 = Throttle-valve switch (full load)
S2 = Throttle-valve switch (idle)
S3 = Connection, transmission switch (in vehicles (with man. shifted transm. to ground)
S4 = Connection, air-conditioner readiness
S5 = Connection, air-conditioner compressor
T1 = Ignition coil with ignition trigger box
X1 = Plug, KE control unit
X2 = Test connection, diagnosis (not California model)
X3 = Plug, parameter encoder
X4 = Plug, ignition trigger box
X5 = Connection, diagnosis interface
Y1 = Tank-ventilation valve
Y2 = Cold-start valve
Y3 = Idle actuator
Y4 = Tank-ventilation switch. valve
Y5 = Electric fuel pump

ELECTRICAL TERMINAL DIAGRAM

K25 ⟹
K26 ⟸



1 = Mixture-control unit
2 = Start valve
3 = Throttle-valve assembly with throttle-valve switch, full load (top) and idle (bottom, not visible in picture)
4 = Idle actuator
5 = Switching valve for tank ventilation
6 = Ignition coil with trigger box, output stage
7 = Ignition distributor
8 = Temperature sensor (engine)
9 = Knock sensor, on engine block, covered by alternator
10 = Tank ventilation valve (pulsed)
11 = Activated carbon filter

INSTALLATION POSITION OF COMPONENTS

K27 — ⟹

K28 — ⟺

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

* Injection valves:
  Inserted into the locating bores of the intake-manifold flanges and secured in pairs by mountings.

* KE-Motronic control unit:
  Above the footwell on the passenger's side between bulkhead and ventilation duct.

  Removal: remove trim in front of glove compartment. Push latching peg toward bulkhead and pull control unit out downwards.

* The fuel-supply components, electric fuel pump, fuel accumulator, and fuel filter:
  On the vehicle underbody on the right in the area in front of the rear axle.

* Catalytic converter and lambda sensor:
  In the exhaust system in the area behind the front axle.

When loosening and tightening joints and connections in fuel lines, make sure everything is clean and counterhold at the fixed hexagon of the respective component.

When connecting electrical cable connectors, make sure they are connected properly and spring clips are latched in tightly.

L01 —— <==

For production reasons:
continued on the following coordinate.

L02 —— => <=